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TREES IN KANSAS

KANSAS' BEST LOVED TREE.
THE STATEHOUSE COTTONWOOD.

PUBLISHED BY THE
KANSAS STATE BOARD OF AGRICULTURE
J. C. MOHLER, SECRETARY
TOPEKA, KANSAS

1928

3.

VOLUME XLVII. NUMBER 186-A.

REPORT

OF THE

Kansas State Board of Agriculture

FOR THE

Quarter Ending June, 1928

TREES IN KANSAS

J. C. MOHLER, *Secretary*
TOPEKA, KANSAS

PRINTED BY KANSAS STATE PRINTING PLANT
B. P. WALKER, STATE PRINTER
TOPEKA 1928
12-3339

Entered at the post office, Topeka, Kan., as second-class matter. Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in section 1103, act of October 3, 1917, authorized on July 31, 1918.

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PREFACE.

THERE is a fascination in wood lore and a satisfaction scarcely to be measured. Its interest is universal and inexhaustible. All through Kansas, from the wooded hillsides and stream margins of the east to the higher plain lands of the west, the tree holds high favor and the landscape is dotted with the groves and orchards planted for home comfort and beauty and for the profitable service they render. No part of Kansas is denied the boon of trees. There are species adapted to conditions in every section, although these are perhaps more numerous in some parts than in others.

To stimulate greater interest in trees and forests is the purpose of this publication. An acquaintance with the trees of Kansas is offered. The adaptability of trees to the various sections of Kansas is made clear, as well as are their uses. Facts concerning what to plant, when to plant, where to plant, and how to plant are given. Accurate information is the basis of successful effort. It is hoped that this report will inspire more earnest work in the improvement of wood lots, better species and better specimens, and encourage the planting of well-selected species in every location in which trees may serve and satisfy.

The Board of Agriculture deems it a privilege to present this volume, and regards it as extremely fortunate that such a valuable manuscript, prepared by Chas. A. Scott, former state forester of Kansas, and Frank C. Gates, of the Department of Botany of the Kansas State Agricultural College, was made available, together with the leading article from the pen of the present state forester, Prof. Albert Dickens. The text, by these foremost authorities, represents years of work, and contains an accumulation of data that should prove of tremendous value in advancing tree culture throughout the entire state. The Board not only desires to acknowledge its indebtedness to the authors for making this report possible, but wishes to commend them in the highest terms for this free-will offering on their part, purely for the sake of promoting interest in trees and forests, for the benefit of Kansas and Kansans.

J. C. MOHLER, *Secretary.*

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TREES IN KANSAS.

THE FOREST SITUATION IN KANSAS,
By ALBERT DICKENS, State Forester.

KANSAS AND HER HISTORIC TREES.
By MARGARET E. WHITTEMORE.

PART I.

KANSAS TREES AND THEIR USES.
By CHAS. A. SCOTT, Former State Forester.

PART II.

HANDBOOK OF KANSAS TREES.
By FRANK C. GATES, Department of Botany,
Kansas State Agricultural College.

A KANSAS LANDSCAPE.

THE FOREST SITUATION IN KANSAS.

By Albert Dickens, State Forester.

KANSAS is a prairie state. Lines or dots locating woodland areas on a map of common size are not visible to the naked eye. The large groves at the confluence of streams and the lines of woodland along their banks are only punctuation marks and column rules in the great pages of the prose and poetry of the prairie. The early estimates of Kansas woodland varied somewhat, but none was above two per cent of the total area, and that made by travelers who did not visit the western parts of the state.

The early settlers found some forested areas in the eastern counties. Many instances are related of homesteaders who preëmpted woodland and cleared it under the impression that land that would not grow trees must be worthless for agricultural purposes. The generation whose parents had cleared forests to make the farms of the Eastern and East Central states could not believe that good farms could be secured by merely breaking up the prairie sod.

There was some heavy timber in early Kansas. Many of the river valleys of southeastern Kansas were quite heavily wooded, and the whine of the sawmill was the first voice of industry in the counties of the eastern half of the state. Thousands of fine saw logs that furnished lumber for the first buildings were cut from along these streams, and as the industries became more diversified the woodland of southeastern Kansas furnished many mine props and much rough lumber for temporary purposes. The refineries of to-day utilize considerable quantities of heavy lumber for securing the shipments of barrels containing oil products. They are not very particular as to species or quality; elm, hackberry, sycamore, or cottonwood, are all classed as native stuff and used without discussion as to botany or tables of durability.

The increase in woodland area in the eastern half of Kansas has come largely from the invasion by various tree species of slopes and ravines that offered favorable conditions for their growth. This struggle for existence is continuous and unceasing. The sumac, buckbush, gooseberry, and many other shrubs find favorable conditions in the shade of the trees which edge the woodland and they in turn serve as nurse plants for the elms and cottonwood seedlings which spring up among them from wind-blown seeds. The squirrels and wood rats forget or neglect the acorns and walnuts which they planted the fall before and these, cracked by winter freezing, furnish a new generation of hardwood trees.

When the settlers provided figureheads, thus protecting the woodland areas from burning, thousands of acres of new woodland developed in the ravines and on adjoining slopes. The soil furnished conditions more favorable for trees than for grass species and Kansas now has more acres of woodland, if not more saw logs, than when the first white men looked over the land.

An ever-increasing proportion of Kansas timber and wood products comes from wood lots that are owned by men whose first interest is farming. Even in Eastern and Central States, where state and federal governments control

large areas and where large forests are managed by individuals or corporations, the importance of the farm wood lot is recognized.

The best interest of the world and the people is served when from a long-time and all-interests-embracing view our lands are devoted to the crops which they are best fitted to produce, and the time has come when certain Kansas lands should be utilized for wood production. A cleared slope may produce grain at a profit for a time, but as erosion cuts away the soil the crop returns less and less and the high cost of erosion is more evident. Finally the poor steep field is sold for taxes, and nobody wants it. The washing soil makes more culvert expense for the township. The heavy run-off of water makes a higher bridge levy necessary for the county. Damage to a main highway cuts into the state road funds; the settling sediment makes higher levees necessary along the lower Mississippi and the engineers of the nation are worried with plans for flood control.

If the poor slope field is acquired by the town for a wood lot, a municipal forest, or a boy scout camp ground, it may be a generation before it will produce cords of wood, posts or poles. But if the forest can make it hold back the run-off water and prevent further loss of soil it is playing a vital part in the cause of conservation.

Kansans are coming to realize that it is good business to keep our land areas protected from washing. Forest-tree planting is one of the effective measures for accomplishing this. Grass or trees on soils that if bare would make trouble for everybody when it rains is good business and sound economics.

Many urban communities need to plan for forest-tree plantings to protect their water supply. Streams which once produced fine fish are so muddy in wet seasons that fish cannot live in them. More trees along the banks and on the water-washed areas above would improve these conditions very materially.

The natural increase of woodland is most gratifying. In thousands of places the trees have triumphed over the grass and annual plant species, reached the level of the broad open lands and now wave a bough of challenge to the eternal prairie.

This tree growth up the slope is more valuable for soil-erosion prevention than for the timber it may produce. On such sites the product of tree species is worth more than the pasturage. For the most part, the species which climb the hills are not our valuable lumber species. In some locations the red cedar predominates. Some red-cedar patriarchs, two feet in diameter, have been preserved in Pottawatomie county. These patriarchs were probably sheltering playing papooses when they unloaded Mary Chilton's hope chest from the Mayflower. Hope chests are still in demand and will be for many times three hundred years. The guilty memory of the cedar trees cut in the "cannons" of Barber county in the seventies and used for the cow yards and corrals of the treeless counties to the north prompts the prediction that the bushy baby cedar trees of to-day will pay good rent for the soil they use, even though payment may be deferred for a few paltry centuries. What is time, rate of interest or date of payment to a tree?

Many of the hillside species make good firewood. Fireplaces are fashionable. Wood fires furnish settings for sentiment. Fashion and sentiment are not price hagglers, and fireplace wood cut in lengths to order is a fancy product compared to common cordwood.

One slope of the Kaw river bluffs in sight of Manhattan has been cut over twice in the past thirty-five years and has a third crop well on the way. These hillsides may be forested by the yellow oak (*Quercus muehlenbergii*), elm, locust, ash and mulberry, which all renew from coppice growth. They sprout with certainty and the occasional trees from seed serve to improve the stand.

The most glorious chapter of Kansas forestry has been written on the pages of the old-time prairies of the Arkansas valley. That sandy old stream and its tribe of southern tributaries, the Ninnescah, the Kiowa, Cavalry, Protection, Chickaskia and Cimarron, were for the most part grass-bordered. Fire was an important cause of treelessness. The Indian of the prairie implored the fire god to keep the warriors of the North tribes away and helped answer his own prayers by seeing to it that every fall a wide belt of burned prairie halted the war parties from the North. The prospect of no game and no pasture for ponies was enough to hold back the invaders.

The occasional timber growth close to the streams that survived the needs of the freighters on the Santa Fe Trail, was cut by the pioneers who had wood contracts for the early forts. The final clean-up of woody species was made by the early settlers whose women folks had such an æsthetic complex that they stubbornly refused to cook with "buffalo chips."

The tale of the growth of trees along the Arkansas and its tributaries is a pleasant one to tell. Fifty years ago these streams ran between grass-covered banks, except where wheat and corn fields hid the water. To-day the river is outlined by lusty trees. The belt varies from a few to many rods in width, but in the aggregate there are thousands of acres of woodland along these streams.

Fifty years is not long in the making of a state, but the first half century of tree-planting in Kansas has given most gratifying results. The lessons that are offered by the successes and failures of the plantings of early days should be well remembered. Tree planting was a fetish in the early years of settlement. Most extravagant statements were made and believed concerning the effects of trees upon wind-run and rainfall. The rapid growth and early success of the trees planted in the fresh, fertile soil encouraged the observer and timber was regarded as a certain source of wealth.

The farm papers printed articles on forestry subjects, and nearly every weekly paper had a column of "Tree Topics" or "Timber Tales." The timber-culture act passed by congress, offering a quarter section of land for the creation of a ten-acre grove, was perhaps the high point in this wave of arboreal enthusiasm. Most of the claims were filed in good faith and many served as demonstrations for the guidance of planters. There was no supervision, no follow-up reports, and seasons of drought brought discouragement.

On soils favorable for trees many fine groves were established, but on high prairie locations most of the "tree claims" were either relinquished to new settlers as the value of land increased or entered as homesteads as the younger member of the family came of age.

Settlers on homesteads and buyers of the cheap "railroad-grant" lands

all planted trees. Usually the first breaking was a hedgerow strip that was useful as a fireguard. The invention of barbed wire lessened the need for hedges, but many long rows of trees outlined the new farms.

The state tried to encourage tree planting. The legislature of 1887 established forestry stations near Dodge City and Ogallah, which for twenty years grew seedling trees for free distribution.

Remembering the results of past plantings, the tree planting of the future must be justified by grim-visaged economics or that brighter-faced goddess, æsthetics. One of these must guarantee results. Present-day tree planting must pay, in posts or pictures, in saw logs or scenery.

Kansas can now afford to wait for results. They are willing to make the long time investment. But hardly again will they muss up good wheat fields or fine alfalfa land with baby forests. Many locations where forest trees should be planted can be found throughout the state. Every side-hill wood lot that holds back the soil, that fights erosion, should be treasured and improved. Every timber lot that holds the banks of a winding stream should be maintained on sound forestry principles. The day may come when the streams should be straightened out to lessen the acreage of banks and wood lots, but always and forever every bank should be protected from the cuttings of flood waters by a fringe of good timber trees.

Every ravine on the hillside farms, which has made two turn-rows necessary where the first plowing required but one, needs either by grass or trees to hold back the water and save the soil. Every pound of soil that goes down the river is so much loss. Kansas fields are young compared to some of our competing wheat-growing lands, but already some of our fields are badly eroded.

The long rows of roadside trees are doomed. They are extravagant sources of wood products. Private landowners cannot afford the ever-widening land borders that the tree tops shade and from which the tree roots absorb the moisture. If the community wants a tree-bordered boulevard they should own it and maintain it, and not complain when the landowner finds it too expensive, converts trees into cash, restores the land to his fields.

The value of many wood lots is being increased by selective cutting, through which young trees of more valuable species are retained for future cutting. In many wood lots a few broad-topped old elms are monopolizing the soil and sun, giving little return themselves but repressing young trees of oak, walnut and ash. They should be started for the barrel factory at once. Sometimes it is worth while for the owner of woodland to introduce the more valuable species.

Oak, walnut and pecan are easily grown from seed. Planting hills are prepared the previous season, by loosening the soil and working it deeply, keeping weeds down and marking the hills with strong stakes. Nuts of good quality are secured, stratified over winter in a box of sand, kept damp, and exposed to freezing and planted in early spring. With a little care during the first few seasons the nut trees make fine progress. Some growers have reported the pecan and walnut bearing at ten years of age and from that age becoming a source of income. Catalpa planted in rich soil makes rapid growth, furnishing posts and poles in ten or fifteen years, and renewing from sprouts very successfully.

Wherever a watercourse or drainage ditch crosses a roadway the need of

trees should be seriously considered. Wherever a stream crosses an important highway a belt of trees should give friendly warning to the approaching driver. Trees are needed at these places. Economics and æsthetics are both served and all concerned, landowner, school district, township, county, state and nation will in time coöperate to secure and maintain such plantings.

Parks, playgrounds and recreational areas are a part of modern life. No one fears to-day that Jack will become dull from lack of play, and it is well to worry about the effect of idleness and plan for his play and recreation. The old swimming hole has been succeeded by the supervised municipal natatorium, and the rural wood lot owner has put up "No Trespassing" signs in self-defense. If the people need the wood lot for recreation and playgrounds they should own it. They can afford to improve the streams, put in dams and make boating, skating and other sports possible, and the wood lots improved and extended may be a source of income and furnish material for industry as the years pass.

Comparisons of the growth and success of native and exotic species of forest trees was one of the early activities of the Kansas State Agricultural College. Many fine trees dating back to plantings of the early seventies inspire students and visitors with enthusiasm for tree planting and forest preservation and extension. Many men who have had a part in the building of the National Forestry Service have learned their early lessons in tree lore from these wood lots and specimen trees on the College campus and farm.

The organization of the Experiment Station of the Agricultural College in 1887 and the Fort Hays Branch station in 1902 has made possible the accumulation of valuable data concerning the growth and adaptability of many species.

Fifty years is but a beginning in forest matters, but the records obtained form the basis for future forestry. Facts may be stubborn but are a much more lasting foundation for success than the fads of fifty years ago.

The most recent advance step is the coöperation of the state with the National Forest Service for the distribution of trees for wood lots, windbreaks, and shelter belts under the provisions of the Clark-McNary act. Through this arrangement species best suited for the various soils and locations of the state are made available to planters at a small cost, and the interest seems nearly equal to that of early days.

The recreational resource of forest areas is being widely utilized. The creation of the Forestry, Fish and Game Commission of our state gives a directing force for acquiring and improving areas suited for forest development and for fishing waters and game preserves.

The idea is becoming prevalent that areas which may provide pleasure for the people should be devoted to this use. Forest-tree planting is an important part of such plans. There is no conflict between the needs of the public and the principles of practical forestry. Timber from trees that have sheltered generations of happy children would not be less valuable because of that service.

Every city and village should consider the possibility of a municipal wood lot. The need of wood for industrial purposes is already apparent, and the coöperation of all factors—village, township, county, state and nation—will be most effective when all join in the work and when the interests of all are served.

KANSAS AND HER HISTORIC TREES.

By Margaret E. Whittemore, Topeka.

In the gracious shade of a mighty tree
I found the peace I sought;
And confidence returned to me
With the quiet strength it brought.

I listened and heard in the voice of a tree
The wisdom it had won
By battling through storm to victory,
By reaching toward the sun.
—*Myra Perrings.*

EVEN Kansas, which is generally believed by outsiders to be only a waste, desertlike plain, is rich in beautiful tree life. Few realize that according to statistics it has 230,233,516 trees, including 3,677,766 fruit trees and 555,750 street trees, besides wild timber, walnut, locust, cottonwood, catalpa, and other varieties. Many of these trees have individual historical interest and associations endearing them to the hearts of the natives of the Sunflower state.

The cottonwood tree was the first to grow at the time of the pioneer white settlers. Its hardiness enabled it to withstand the drought and heat and rendered it of much value to the newcomers. Near Garden City two roads lead from the town, lined on either side with large cottonwoods. One is called "Lover's Lane," and both highways are beautiful with their canopies of interlocked branches.

Another beloved cottonwood is located a few feet east of the south wing of the state capitol building in Topeka. It is a very large and beautiful tree of almost perfect symmetry, with a spread of about 100 feet. There are several stories as to the origin of this tree. It is said that it grew from a seed and that it is the only naturally grown tree on the statehouse grounds. In 1868, derricks were used for lifting material while the building of the east wing was in progress. At this time several big cottonwood boughs were brought up from the river to be used as stakes for the guy ropes. Some believe the tree sprouted from one of these boughs.

Former Presidents Harrison, McKinley and Taft made campaign speeches beneath it, and under it many generations of children have played. It is loved not only for its historical associations, but also for its grace and beauty.

A cottonwood tree west of Englewood is said to be the largest in Kansas. It is thirty-one feet in circumference and already was large when the first white settlers located there forty-five years ago. On the road to Maplehill, just a few miles west of Topeka, is a cottonwood, the silhouette of which bears a marked resemblance to a Dutch windmill, especially at a distance. This tree was the inspiration for the following lines by the young Kansas poet, Edna Becker:

THE WINDMILL TREE.

Upon a lonely hill there stood
Commandingly, a cottonwood.
Its stately boughs outstretched. In pride
It faced the wooded countryside.
One night there came with lightning flash,
Downpouring rain and thunder's crash,

A twisting storm whose rending roar
Swept through the neighborhood and tore
At those proud limbs; when morning light
Brought the havoc to our sight,
The cottonwood stood spent and torn,
Of its tall grace and beauty shorn—
A crushing blow, but yet the tree
Bore it philosophically
And made the most of what remained.
A reputation now it's gained;
For people who pass by that way,
See it standing there and say,
"Now, doesn't that tree on the hill
Look just like a Dutch windmill?"

Near Baldwin stands the celebrated "Signal Oak." Its isolated location makes it conspicuous for miles around. It was by use of this tree that pioneers were able to spread the alarm of an invading foe and so save the first college in Kansas from annihilation.

The "Kit Carson" tree is an elm near Halstead on the bank of Black Kettle creek. It served as a marker for travel for the Arapahoe and Osage Indian hunters. According to a local story, it was here that Kit Carson and his band of emigrants camped for the night. At three o'clock in the morning the yells of the Comanche Indians were heard in the surprised little camp. Kit Carson led in the defense against the Indians, of whom Chief Black Kettle and Chief Hard Rope were the commanders. The ammuniation of the white men was running low and the Indians were formed for a final charge when a company of United States cavalry, commanded by General Custer, dashed to their relief and the Indians were forced to retreat. In 1867 General Custer camped under a tree at Council Grove which has kept the name "Custer Elm" in memory of the event.

Another historic tree at Council Grove is the "Council Oak." This marks the place of the treaty signed August 10, 1825, between the United States commissioners and the Indians, for unmolested use of the Santa Fe Trail across the Great Plains. George C. Sibley, one of the commissioners of that day, said that he gave the tree that name and had "Big John Walker," one of his men, carve the name "Council Grove" on the large oak. The town always has retained that name in honor of the occurrence.

The oldest tree in Olathe is a maple under which the Delaware and Wyandotte Indians made a treaty of peace. It is more than fifty years old and ninety feet high. In 1905 the city council and street department decided that this tree would have to come down, since it stood in the way of a proposed sidewalk. Mrs. Jennie Baker and her daughter, on whose property the tree stood, marched round and round it to prevent the men with axes from doing their work of destruction. Three-fourths of the population of Olathe came to their assistance and protected the tree until legal aid was obtained for its permanent protection.

A Topeka tree associated with the events of the Civil War is located in the parking at the corner of Huntoon and Clay streets. It is a handsome locust and has stood for at least fifty years. In early days it was the only tree within a radius of three miles from Shunganunga creek to the Kaw river. Under it public-school children of Topeka placed a cement block inscribed with these

words: "The oldest tree in Topeka. The 3-B grade of 1912. Central Park School."

Many years ago thirty Vermonters settled in Kansas on the Little Osage river in Bourbon county, where all took claims. It was called the Vermont colony. A quarter section of land was settled for a town site, and in 1857 the question arose as to a name. Because of the large number of maple trees in that place, the name Mapleton was chosen. There was at that time only one other town in the United States having that name, whereas now there are twenty. There is an old tavern at Mapleton built entirely of walnut; frame, siding, interior finish and shingles—all grown along the Osage river a mile or so distant.

Many other trees of beauty and especial interest might be mentioned—the oaks of central Kansas, rich in foliage; the black walnuts of western Kansas; and the enormous sycamores growing along the alluvial bottom lands of the Neosho, Verdigris, Osage, Kansas, and other streams and rivers.

Seeing the valiant struggle made by trees, living sometimes under adverse conditions, showing dogged perseverance in the teeth of misfortune, and lifting their leafy boughs far above it all, one feels that their splendid example is one which all may follow.

THE COTTONWOOD.

By I. D. Graham, Topeka, Kan.

IN KANSAS every old tree suggests the camp fires and wigwams of a vanished race and spreads its shade over a history in the making. To the prairie pioneer, whose horizon was bounded only by his power of vision, a tree among the billowing waves of green became as a sail on the sea, a harbinger of hope and contact with the infinite spaces.

The nomad needs no tree, and among the Argonauts whose restless feet carried them across the far-flung plans to the gold hills of the West, none stopped to plant the seeds and compose the land's first temples.

To the nation builders who later came, the plains and sky were types of the infinite and trees were needed to make humanity more human by protecting the earth's holiest spot—the home.

A pioneer among the trees and a missionary of better things to come was the cottonwood, lifting its stately head to the sun and pointing to the midnight stars, drawing its sustenance from the bosom of Mother Earth, breasting with bared frame the winter's blasts and sending forth its pean of praise in a thousand æolian voices with the summer's breeze, it spread its shade like a benediction over the land.

A meed of praise to the cottonwood, the tree of the pioneer, of small intrinsic value but of unmeasured worth in rapid growth, in stately mein, in bounteous shade and as the beginning of the groves which healed the nostalgia of the home finder in an untried land and made a playhouse for the child who became the Kansan.

PART I.

KANSAS TREES AND THEIR USES.

By Chas. A. Scott, Former State Forester.

There are two classes of commercial trees—conifers and broad-leaved.

CONIFERS.

The conifers are the cone-bearing trees. Most of them retain their leaves throughout the entire year, hence as a group they are commonly known as "evergreens." Evergreens include some of the hardiest drought-resistant trees known. Several of them are well adapted to Kansas soil and climate, being most valuable for protective and ornamental planting. They make a height growth of from 12 to 30 inches per year, which compares favorably with the rate of growth of the broad-leaved species. They are long-lived, comparatively free from insect attack, and suffer less injury from hail and windstorms than do the broad-leaved species.

Because the evergreen trees retain their leaves, they afford greater protection from the wind during the winter than do the broad-leaved deciduous trees. A few rows or a clump properly located makes the best windbreak that it is possible to grow. They will grow in the poorest rocky or sandy soils in the state, as well as in the driest clay soils. They should not be planted in gumbo, alkali, or poorly drained soils. Most of the evergreen trees are highly ornamental and merit greater consideration for yard planting than they have received in this state.

In planting evergreen trees only transplanted stock should be used. When several hundred are to be planted for hedges, windbreaks, or wood lots, transplanted stock 12 to 18 inches in height gives the best results. Trees of this size cost less, are more cheaply planted, and sustain no greater loss than the larger sizes. When only a few are to be set, larger-sized stock is more desirable, since they have ornamental value from the time they are planted. Trees from 3 to 5 feet in height may be used. However, this size can be handled safely only when balled and burlapped; *i. e.*, with balls of earth bound securely about the roots.

BROAD-LEAVED TREES.

The broad-leaved trees are known commercially as "hardwoods" and include all trees not included in the evergreen group. Native trees, such as the elm, ash, oak, cottonwood, basswood, and maple, are included in this group. Some of these trees retain their leaves throughout the greater part of the year; as for example, the holly, magnolia, live oak, and most of the trees of the tropics. They are seldom referred to as evergreens, however, and are never grouped as such botanically. The hardiness of the broad-leaved trees varies with each species. Many of them are well adapted to eastern Kansas conditions and the hardiest of them grow successfully in western Kansas.

Fig. 1.—A block of evergreen seedling beds in the State Forest Nursery. Note construction of the seed-bed frames and lattice covering to protect the plants from wind, sun, rain and hail.

CLIMATIC ADAPTATIONS.

Because of the great difference in climate between the eastern and the western part of Kansas, it is necessary to choose trees suited to the section in which they are to be grown. The following lists indicate the species adapted for the different sections of the state.

Trees and Native Shrubs for the Section in Which the Annual Rainfall Exceeds Thirty-five Inches.

EVERGREENS SUITABLE FOR PROTECTIVE AND ORNAMENTAL PLANTING.

White pine (*Pinus strobus*).
Table mountain pine (*Pinus pungens*).
Pitch pine (*Pinus rigida*).
Austrian pine (*Pinus nigra austriaca*).
Scotch pine (*Pinus sylvestris*).
Swiss mountain pine (*Pinus mugo mughus*).
Colorado blue spruce (*Picea pungens*).
White spruce (*Picea glauca*).
Engelmann spruce, Black Hills spruce (*Picea engelmanni*).
Norway spruce (*Picea abies*).
Douglas fir (*Pseudotsuga taxifolia*).
White or silver fir (*Abies concolor*).
Chinese arborvitæ (*Thuja orientalis*).
Bald cypress (*Taxodium distichum*).
Dwarf juniper (*Juniperus communis* var. *depressa*).
Red cedar (*Juniperus virginiana*).

BROAD-LEAVED SPECIES SUITABLE FOR STREET AND YARD PLANTING.

Black sugar maple (*Acer nigrum*).
Silver maple (*Acer saccharinum*).
White oak (*Quercus alba*).
Red oak (*Quercus maxima*).
Pin oak (*Quercus palustris*).
Bur oak (*Quercus macrocarpa*).
Hackberry (*Celtis occidentalis*).
White elm (*Ulmus americana*).
Rock or cork elm (*Ulmus racemosa*).
English elm (*Ulmus campestris*).
Tulip tree (*Liriodendron tulipifera*).
Sycamore or plane tree (*Platanus occidentalis*).
Black cherry (*Prunus serotina*).
Redbud (*Cercis canadensis*).
Coffee tree (*Gymnocladus dioica*).
Thornless honey locust (*Gleditsia triacanthos inermis*).
White ash (*Fraxinus americana*).
Green ash (*Fraxinus lanceolata*).
Russian olive (*Elæagnus angustifolia*).
Pecan (*Hicoria pecan*).
River birch (*Betula nigra*).

Basswood (*Tilia glabra*).
Carolina poplar (*Populus canadensis*).
Tree of heaven (*Ailanthus altissima*).
Red Haw (*Cratægus mollis*).
Cockspur (*Cratægus crus-galli*).
Wild crab (*Malus iœnsis*).
Service berry (*Amelanchier canadensis*).
Sumac (*Rhus copallina*).
Smooth sumac (*Rhus glabra*).

TREES SUITABLE FOR WOOD-LOT PLANTING.

Austrian pine (*Pinus nigra austriaca*).
Red cedar (*Juniperus virginiana*).
Cottonwood (*Populus sargentii*).
Black walnut (*Juglans nigra*).
Hardy catalpa (*Catalpa speciosa*).
Bur oak (*Quercus macrocarpa*).
Red oak (*Quercus maxima*).
Pecan (*Hicoria pecan*).
White ash (*Fraxinus americana*).
Osage orange (*Toxylon pomiferum*).

Trees and Shrubs for the Section in Which the Annual Rainfall is Between Twenty-five and Thirty-five Inches.

EVERGREENS SUITABLE FOR PROTECTIVE AND ORNAMENTAL PLANTING.

Western yellow pine (*Pinus ponderosa*).
Table mountain pine (*Pinus pungens*).
Austrian pine (*Pinus nigra austriaca*).
Scotch pine (*Pinus sylvestris*).
Swiss mountain pine (*Pinus mugo mughus*).
Colorado blue spruce (*Picea pungens*).
Engelmann spruce, Black Hills spruce (*Picea engelmanni*).
Douglas fir (*Pseudotsuga taxifolia*).
White or silver fir (*Abies concolor*).
Chinese arbor vitæ (*Thuja orientalis*).
Dwarf juniper (*Juniperus communis var. depressa*).
Red cedar (*Juniperus virginiana*).

BROAD-LEAVED SPECIES SUITABLE FOR STREET AND YARD PLANTING.

Silver maple (*Acer saccharinum*).
Red oak (*Quercus maxima*).
Pin oak (*Quercus palustris*).
Bur oak (*Quercus macrocarpa*).
Hackberry (*Celtis occidentalis*).
White elm (*Ulmus americana*).
Chinese elms (*Ulmus pumila* and *U. japonica*).
Rock or cork elm (*Ulmus racemosa*).
English elm (*Ulmus campestris*).
Tulip tree (*Liriodendron tulipifera*).

Sycamore or plane tree (*Platanus occidentalis*).
Black cherry (*Prunus serotina*).
Coffee tree (*Gymnocladus dioica*).
Thornless honey locust (*Gleditsia triacanthos inermis*).
Green ash (*Fraxinus lanceolata*).
Russian olive (*Elaeagnus angustifolia*).
Pecan (*Hicoria pecan*).
Basswood (*Tilia glabra*).
Carolina poplar (*Populus canadensis*).
Norway poplar (*Populus canadensis var.*).
Ailanthus, tree of heaven (*Ailanthus altissima*).
Redbud (*Cercis canadensis*).
Wild crab (*Malus iœnsis*).
Smooth sumac (*Rhus glabra*).
Sumac (*Rhus copallina*).
Red haw (*Cratægus mollis*).
Cockspur (*Cratægus crus-galli*).

TREES SUITABLE FOR WOOD-LOT PLANTING.

Austrian pine (*Pinus nigra austriaca*).
Red cedar (*Juniperus virginiana*).
Chinese arbor vitæ (*Thuja orientalis*).
Cottonwood (*Populus deltoides* or *P. Sargentii*).
Black walnut (*Juglans nigra*).
Hardy catalpa (*Catalpa speciosa*).
Bur oak (*Quercus macrocarpa*).
Red oak (*Quercus maxima*).
Pecan (*Hicoria pecan*).
Osage orange (*Toxylon pomiferum*).

Trees for the Section in Which the Annual Rainfall is Less than Twenty-five Inches.

EVERGREENS SUITABLE FOR PROTECTIVE AND ORNAMENTAL PLANTING.

Red cedar (*Juniperus virginiana*).
Dwarf juniper (*Juniperus communis depressa*).
Chinese arbor vitæ (*Thuja orientalis*).
Austrian pine (*Pinus nigra austriaca*).
Scotch pine (*Pinus sylvestris*).
Western yellow pine (*Pinus ponderosa*).

BROAD-LEAVED SPECIES SUITABLE FOR STREET AND YARD PLANTING.

Thornless honey locust (*Gleditsia triacanthos inermis*).
Hackberry (*Celtis occidentalis*).
White elm (*Ulmus americana*).
Chinese elms (*Ulmus pumila* and *U. japonica*).
Green ash (*Fraxinus lanceolata*).
Russian olive (*Elæagnus angustifolia*).
Osage orange (*Toxylon pomiferum*).
Russian mulberry (nonfruiting only) (*Morus alba*).

TREES SUITABLE FOR WOODLOT PLANTING.

Austrian pine (*Pinus nigra austriaca*).
Red cedar (*Juniperus virginiana*).
Chinese arbor vitæ (*Thuja orientalis*).
Cottonwood (*Populus sargentii*).
Osage orange (*Toxylon pomiferum*).
Coffee tree (*Gymnocladus dioica*).
Black walnut (*Juglans nigra*).
Russian mulberry (*Morus alba*).

FIG. 2.—Two-year-old transplanted red cedars in the nursery row in the State Forest Nursery.

FIG. 3.—A block of catalpa seedlings in the State Forest Nursery, Hays, Kan.

SOIL ADAPTATIONS.

The selection of trees for any definite locality in this region must be determined by the character of soil in which they are to be planted. The following are well adapted for heavy-loam upland soil:

Red cedar.	Hackberry.
Scotch pine.	Honey locust.
Austrian pine.	Osage orange.
Western yellow pine.	Russian olive.
Chinese arbor vitæ.	Green ash.
White elm.	

For planting on loam soil in valley lands along the watercourses or in ravines, the cottonwood, black walnut and coffee tree may be added to the above list.

Fig. 4.—A block of 15,000 transplanted 4- to 8-foot white elm trees in the State Forest Nursery.

For planting in light sandy soil, such as sand dunes or in sandy river valley soil, the following are satisfactory: Red cedar, Austrian pine, Western yellow pine, Scotch pine, Jack pine. In sandy loam soil the cottonwood, osage orange, and Russian mulberry may be added to the above list.

The boxelder, soft maple, Carolina poplar and others of the more rapidly growing species are omitted from this list because they are at best but short-lived in this section. They reach their development in about fifteen or twenty years, and then die. Whenever these species are planted they should be in a mixture with some of the longer-lived species, such as the white elm, hackberry, honey locust and Russian olive. These trees, while slower in their development, will attain sufficient size to occupy the ground fully and take the place of the shorter-lived trees by the time the latter begin to die.

THE STATE FOREST NURSERY.

Because of the insistent and growing demand from the people of the western part of the state, the Department of Forestry of the Kansas Agricultural Experiment Station has established a State Forest Nursery at the Fort Hays Branch Experiment Station, Hays, Kan.

The purpose of this nursery is to supply stock suitable for planting in western Kansas. When the trees produced here reach sufficient size they are sold to the actual planters at cost of production. The price of this stock varies with the species, age, grade and season.

FIG. 5.—A block of 20,000 3-year-old 5- to 9-foot honey locust trees in the State Forest Nursery.

FIG. 6.—A block of 50,000 3-year-old 4- to 9-foot green ash trees in the State Forest Nursery.

GROWING NURSERY STOCK.

The growing of evergreen stock requires the attention of a skilled and experienced nurseryman. The seed may be sown either in the fall or spring in well-prepared beds inclosed with a frame of boards and wire netting and covered with a lattice roof. The inclosure is to protect the seeds and seedlings from birds and animals, while the lattice roof shields them from the sun, wind, rain and hail. Most of the evergreen seedlings that survive under natural conditions grow in partial shade for a time. Very few of them can endure the full sunlight during the first summer. During their first season the seedlings are subject to several plant diseases, and it is this period that tests a nurseryman's skill in saving his stock.

FIG. 7.—A tamarix hedge growing at the Fort Hays Branch Experiment Station, Hays, Kan. This hedge was grown without irrigation. It was sheared about once every two weeks throughout the summer to keep it in good form. The different forms show how the hedge may be developed. The clump at the further end shows the unsheared natural development. The tamarix is entirely hardy in western Kansas and it is well adapted for hedges and ornamental planting.

At 1 or 2 years of age they are transplanted to nursery rows, where they are grown from 1 to 3 years, or until of suitable size to plant in their permanent location.

The seeds of the broad-leaved species are usually sown in the open field in nursery rows, where the stock grows without being transplanted, until of sufficient size for permanent planting; but it is usually root pruned at 1 or 2 years of age. The broad-leaved seedlings are less liable to plant diseases than the evergreen seedlings, and they grow with much more vigor, attaining heights varying from 1 to 3 feet in a single season. At 1, 2 and 3 years of age this stock is of suitable size for wood-lot and windbreak planting.

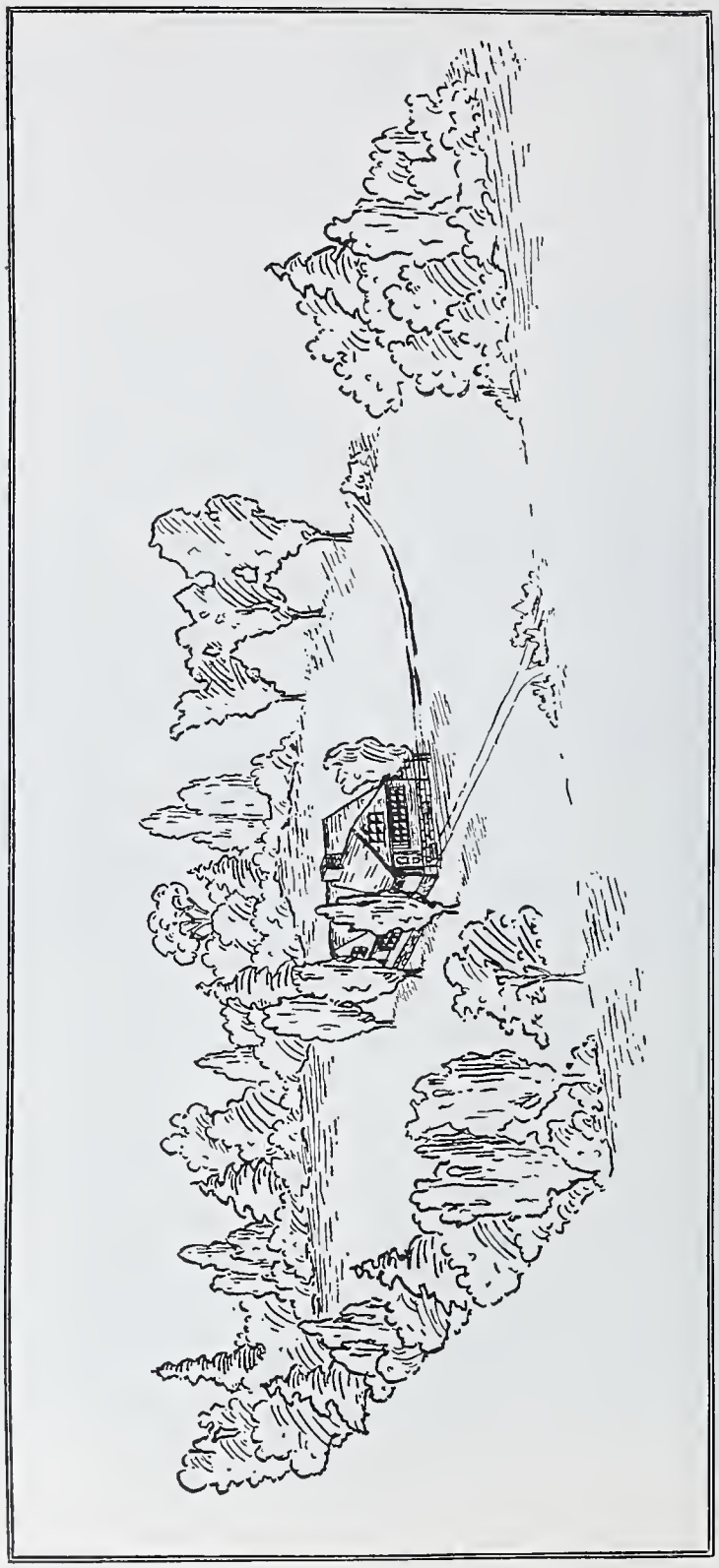


FIG. 8.—A well-planted school yard.

INSTRUCTIONS FOR PLANTING.

Success in growing trees and shrubs is dependent upon three factors: First, the selection of suitable trees and shrubs adapted to existing soil and climatic conditions; second, the proper preparation of the soil and careful planting of trees and shrubs; third, the cultivation and protection of trees and shrubs after planting.

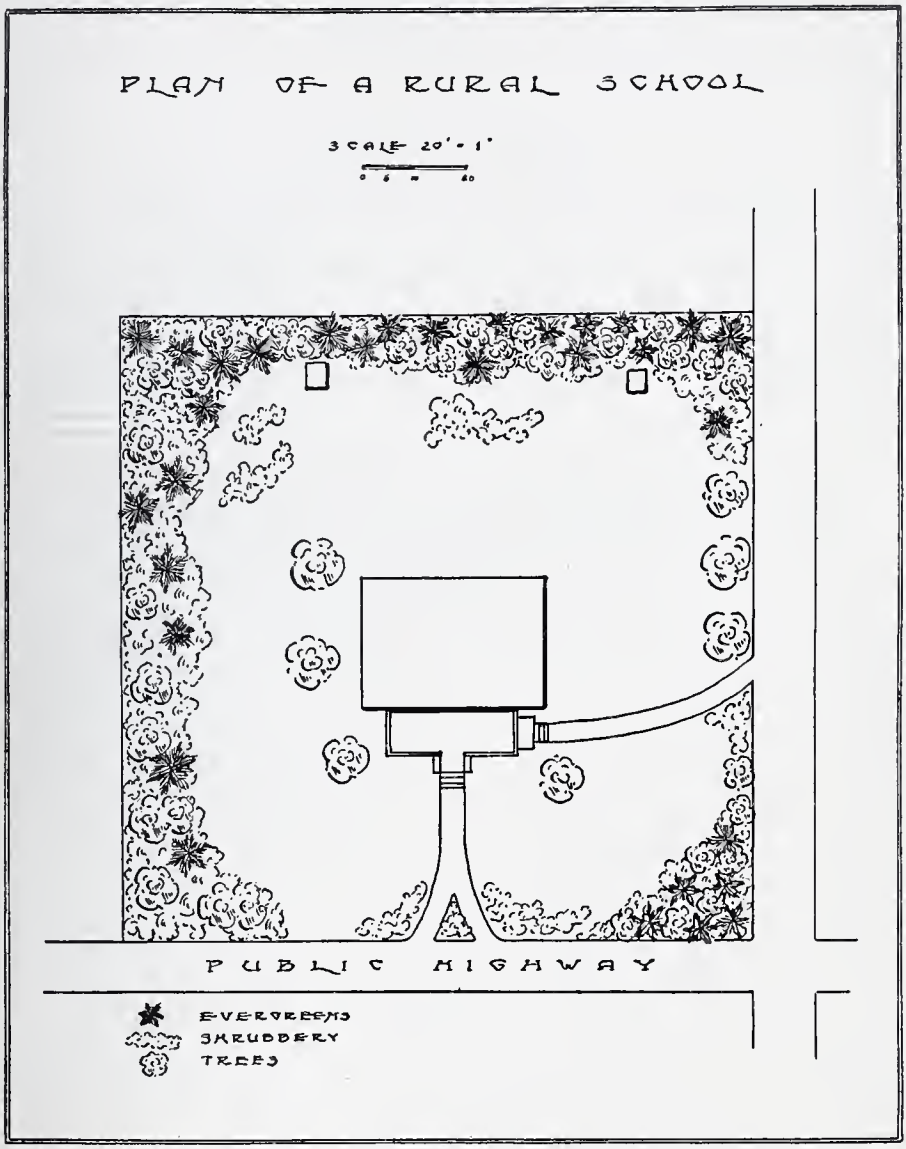


FIG. 9.—A plan for planting a school yard located at crossroads and bounded on the south and east by public highways. The principal features of this plan are four shade trees on the south and west to protect the building from the heat of the summer sun; an open row of trees along the east side of the yard; a clump of trees in the southeast and southwest corners, skirted with shrubbery, and broken clumps of shrubbery along the border directly in front of the building. Along the west and north borders the trees are set more thickly, and heavy masses of shrubbery supplement the trees to screen the outhouses and protect the yard from sweeping winds.

Selection of Species.

The selection of trees and shrubs to be planted should be made from a list of known hardy and desirable species. This list can best be made up after a careful survey of the trees and shrubs growing in the community in question and by consulting recognized authorities on trees and shrubs.

To merit a place in a well-kept yard, the trees must be pleasing in general appearance, free from litter of any kind, shapely and well balanced, wind firm, and, above all else, long-lived. Large-sized trees are usually preferable, but often there is a place for medium and even small-sized trees in school yards, parks and public grounds.

Preparation of the Soil.

The preparation of the soil for tree planting is, next to the selection of species, the most important step in successful tree growing. Trees cannot grow unless there is sufficient moisture in the soil to keep them in a thrifty condition. A tree when transplanted loses a considerable portion of its root system. Consequently the first thing a newly planted tree must do is to develop a new system of roots and establish itself in its new location. To do this and at the same time support a growth of leaves requires a liberal supply of moisture. This need is best supplied when the soil contains a considerable amount of moisture at planting time.

The soil in which the tree is to be planted should be spaded up several weeks or months before the trees are planted. The depth to which the ground should be loosened will depend entirely upon the character of the subsoil. If the *subsoil* is hard "jointed clay" it will be advisable to spade up the soil to a depth of 2 or 3 feet over an area 6 feet or more in diameter. In case the subsoil is loamy, spading to a depth of 18 or 20 inches will be sufficient. The loosened mass of soil should be shoveled back into the hole to pulverize under the action of freezing and thawing and to absorb and retain the moisture that falls in the form of rain and snow. When a supply of water is available this loosened mass of soil should be thoroughly wet a few days before the trees are planted and should remain undisturbed until the tree holes are dug. Moistening the soil in this way gives much better results than planting the trees in dry soil and watering them immediately after they are set.

The practice of leaving the holes in which trees are to be planted open for weeks or months before the trees are planted is a serious mistake. Such practice permits the soil to become air dry, and if the subsoil contains clay, to bake and harden. Such a condition is difficult to correct. The holes for trees should be dug only when the trees are ready to set. The moist soil taken out of the hole is then in good condition to fill in about the roots, and will reunite readily with the bottom and sides of the hole. This cannot occur when the hole is left open for some time before the tree is planted.

Time to Plant.

Most successful results are secured from early spring planting. The latter part of March or early April is the proper time to plant either evergreen or broad-leaved species. Early planting allows the roots to begin growth by the time the buds are bursting and to supply the needed moisture for the tree.

Late spring planting is objectionable because the leaves come out before the new roots develop, and the tree is liable to die and certain to suffer greatly from the lack of moisture. For the same reason fall planting is unsafe in localities where the autumn and winter seasons are dry. Trees set in the fall in dry soil do not develop feeding roots until the following spring, and during the winter months there is great danger of the stems and branches becoming thoroughly dry by transpiration through the pores in the bark.

Methods of Planting.

In planting trees the holes should be dug fully twice as wide and twice as deep as the roots require in their natural position. By this method the soil is thoroughly worked over and pulverized, and is capable of absorbing and retaining a greater amount of moisture than would otherwise be possible. Loosening and aërating the soil liberates the plant food and induces a vigorous growth. The tree should be set in place at about the same depth that it grew in the nursery, and the roots should be spread naturally, covered with 3 or 4 inches of soil, and tramped firmly. The object of firming the soil is to bring the roots and soil in close contact. After this the hole should be filled and firmed to within a few inches of the level of the surrounding ground. The surface should be left in a loose condition for a mulch.

Cultivation and Protection.

After the trees are planted they demand as careful cultivation as any crop. This fact is too often overlooked in the care of trees. It is unreasonable to expect newly planted trees to compete successfully with the native plants of the region. Cultivation conserves the soil moisture by preventing evaporation, and keeps down other vegetation which would use the moisture needed by the trees. The cultivation need not be deep, but must be thorough. The more intensive the cultivation the greater the success will be.

Newly planted trees require protection against injury by the sun, wind and animals. Protection against injury by the sun and wind is required by the evergreens more than by the broad-leaved species. Furthermore, because evergreens are in full foliage when they are planted, there is considerable danger that they will suffer from the effect of excessive transpiration. To guard against this danger a screen of some kind should surround them. When only a few trees are involved, small boxes with their tops and bottoms knocked out can be set around the trees. Empty nail kegs will also answer the purpose. A screen of burlap tacked to three or four stakes at equal distances around the tree answers the purpose very well. For extensive planting, as in groves and shelter belts, shingles or short pieces of light box boards from 6 to 8 inches in width, driven into the ground a few inches from the tree on the southwest side, provide excellent protection. Some protection of this nature is very necessary during the first month or six weeks after the evergreens are planted.

The broad-leaved species will require no special protection, except from rabbits. Their stems should be wrapped with burlap, grass, cornstalks, or wooden veneer tree protectors.

Live stock of all kinds must be rigidly excluded from the area occupied by young trees. Browsing off the tips of the branches, rubbing against the stems

and trampling the ground around the trees are all detrimental, and cannot be permitted if successful growth is to be secured.

When leaf-eating insects threaten, the trees should be sprayed with an arsenical spray. To protect against borers, the stems of the newly planted trees may be painted with a saturated solution of sal soda, to which enough laundry soap has been added to make a thick paint. Carbolic acid is then added

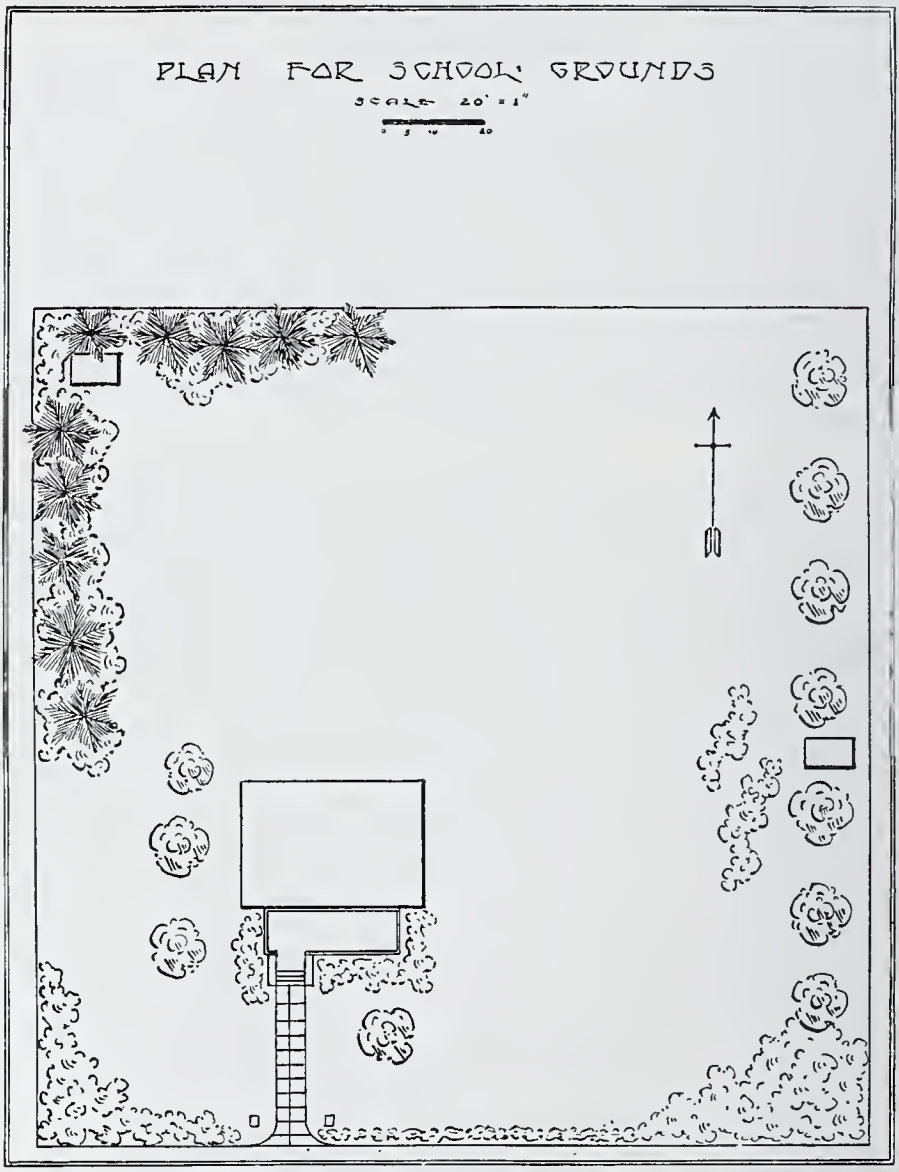


FIG. 10.—A plan for planting a school yard located where it faces the highway in but one direction and that to the south. The principal features of this plan are four shade trees on the south and west to protect the building from the heat of the summer sun; an open row of rees along the east side of the yard; a clump of shrubbery in the southeast and southwest corners; a low evergreen hedge directly in front of the building, and a line of evergreens in the northwest corner of the yard, skirted by a heavy fringe of shrubbery to screen the outhouse and protect the yard from the sweeping winds.

to this mixture at the rate of 1 pint to 10 gallons. This should be applied frequently enough to keep the stems completely coated from the first of May to the middle of August during the first and second seasons.

Yard Planting.

The proper location of trees in a yard is a matter that requires special study in the planning of each yard. The objects to be attained are twofold: *protection* and *ornamentation*. The protection of the yard and house must be the first consideration. To accomplish this the trees must be so located as to shield the house from the direct heat of the sun during the summer months, and from the sweep of the winds during the winter months. To secure these objects the shade trees must be planted south and west of the building, and the trees forming the windbreak must be grouped on the north and the northwest sides of the yard. A few general rules are helpful in deciding upon the exact location of the trees. They must not be planted too close to the house, or they will be objectionable, because they will make the building dark, damp and gloomy. It is difficult at the time of planting a sapling 8 to 12 feet in height to realize that it may some day be a tree 60 feet or more in height, with a spread of limbs that will exceed in distance its height. The distance that a tree should be planted from the building must be determined by the size it will attain at maturity. A tree that does not exced 20 feet in height may be planted within 8 or 10 feet of the house, while a tree that attains a height of 60 feet or more should be planted 20 or 30 feet from the house. To grow symmetrically and develop a well-balanced crown, a tree must have unobstructed room. The permanent trees should be spaced from 30 to 40 feet apart. It is often desirable to plant quick-growing, short-lived trees in mixture with the permanent trees. When this is done the trees may be spaced from 16 to 20 feet apart, and the temporary trees should alternate as uniformly as possible with the permanent trees.

The trees that are planted for protection against the winds may well be of one or more species of evergreens, planted in groups or clumps, so that they will give the desired protection and at the same time add much to the cozy appearance of the yard. Such groups or clumps should be located around the border of the yard.

After satisfying the demand for protection, the beautifying of the yard must be considered, and in this the object to be attained is to make the yard as attractive as possible. In such planting, shrubbery must be combined with trees. Nothing that can be planted in a yard gives a more pleasing effect than well-arranged masses of shrubbery. A good place to begin this planting is around the building. The foundation walls should be hidden, the corners in the angles of the house and at the ends of the porch should be banked. After this is done a border of shrubbery defining the limits of the yard may be artistically arranged. Masses of shrubbery may be used to supplement the trees to screen the outbuildings. In all this planting the shrubbery must be massed to eliminate the individuality of each plant and to give the appearance of coziness to the entire yard. The border of shrubbery along the sides of the yard serves as a windbreak to protect the grounds from the sweep of the wind and to give the entire landscape a more congenial aspect.

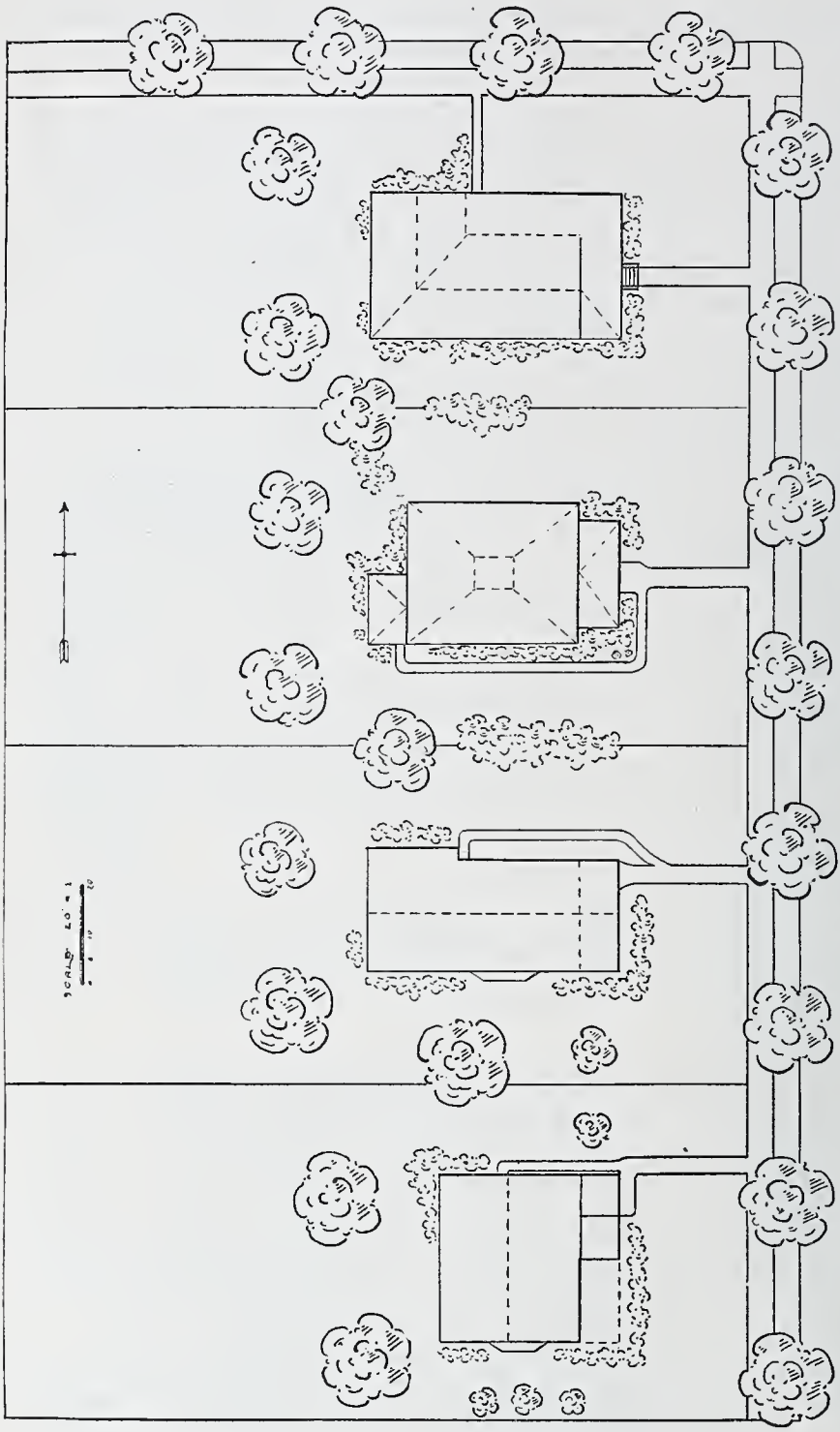


FIG. 11.—A plan showing the location for trees and shrubbery on town lots. In this sketch the street trees provide shade for the front yard during the forenoon. The trees in the back yard and between the houses furnish protection during the heat of the afternoon. The arrangement of the shrubbery obscures the foundation walls and fills in the angles around the ends of the porch and elsewhere about the buildings. The clumps of shrubbery between the houses are designed especially to obscure the back yards.

In all this mass planting the dwarf, lower-growing shrubs should be planted in the foreground, with the taller-growing shrubs behind them, grading to the tallest in the extreme rear. The one feature that should be avoided in all yard planting is the haphazard planting of single shrubs over the entire yard. Such arrangement gives the effect of a curiosity shop; a yard full of individual plants detracts from the appearance of the yard as a whole. The front yard should be left open, and, as far as possible, it should be an unbroken greensward. This arrangement makes the house and yard the central object of the picture and gives an effectiveness that cannot be otherwise secured.

One essential feature in all yard planting should be a definite plan prepared beforehand to serve as a guide in determining the location of trees and shrubs and the species to be used. It is not expected that all the planting will be done in one season, but rather that it should extend over a number of years, and the amount done each year should be in accordance with the planting plan, so that ultimately the planting will embrace all covered by the plan. This will allow time to care for the trees and shrubs set out from year to year, and it should be borne in mind that the care of the trees and shrubs after they are planted is one of the important features of the work. A plan for planting should not be too complex or too difficult to carry out. Simplicity in the plans will insure their adoption and execution. The planting plan should be carefully prepared and kept where it may be studied by all who are interested in the work.

Street Planting.

In street planting the trees are usually set in the parking between the sidewalk and the curbing. When the street is extremely wide, 100 feet or more, a strip of parking 20 feet or more in width in the center of the street may be devoted to growing dwarf trees and shrubs, but there is not sufficient room in the street for three rows of standard-sized trees. On the average street the distance from property line to property line may be divided on the basis of two-fifths for sidewalks and three-fifths for roadway. Residence streets are usually 50 feet wide. This arrangement allows a 30-foot roadway and 10 feet on either side for sidewalk space, that can be divided as follows: 5 feet for parking, 4 feet for walk, and a 1-foot sod strip between the walk and the property line. This is a very convenient arrangement on streets where traffic is not heavy. Streets on which the traffic is very heavy should be not less than 60 feet from property line to property line. Following the same scheme for dividing the distance as before, the roadway will be 36 feet wide, and 12 feet on either side will be devoted to sidewalk space. This will allow 6 feet for parking, 5 feet for walk, and 1 foot for a sod strip between walk and property line. The roadway should be confined to as narrow limits as will meet the needs. The narrower the roadway the cheaper will be the cost of maintenance. Narrow roadways usually mean better-kept streets, broader strips of parking, thriftier trees, more green grass, and less dust in the houses. There is nothing that makes a street more inviting than well-kept trees and lawns. Too many trees are objectionable; they give a place the appearance of being cramped and overcrowded.

The one feature in street planting that is disregarded more than any other is the uniformity of species. Street planting, by the very nature of its char-

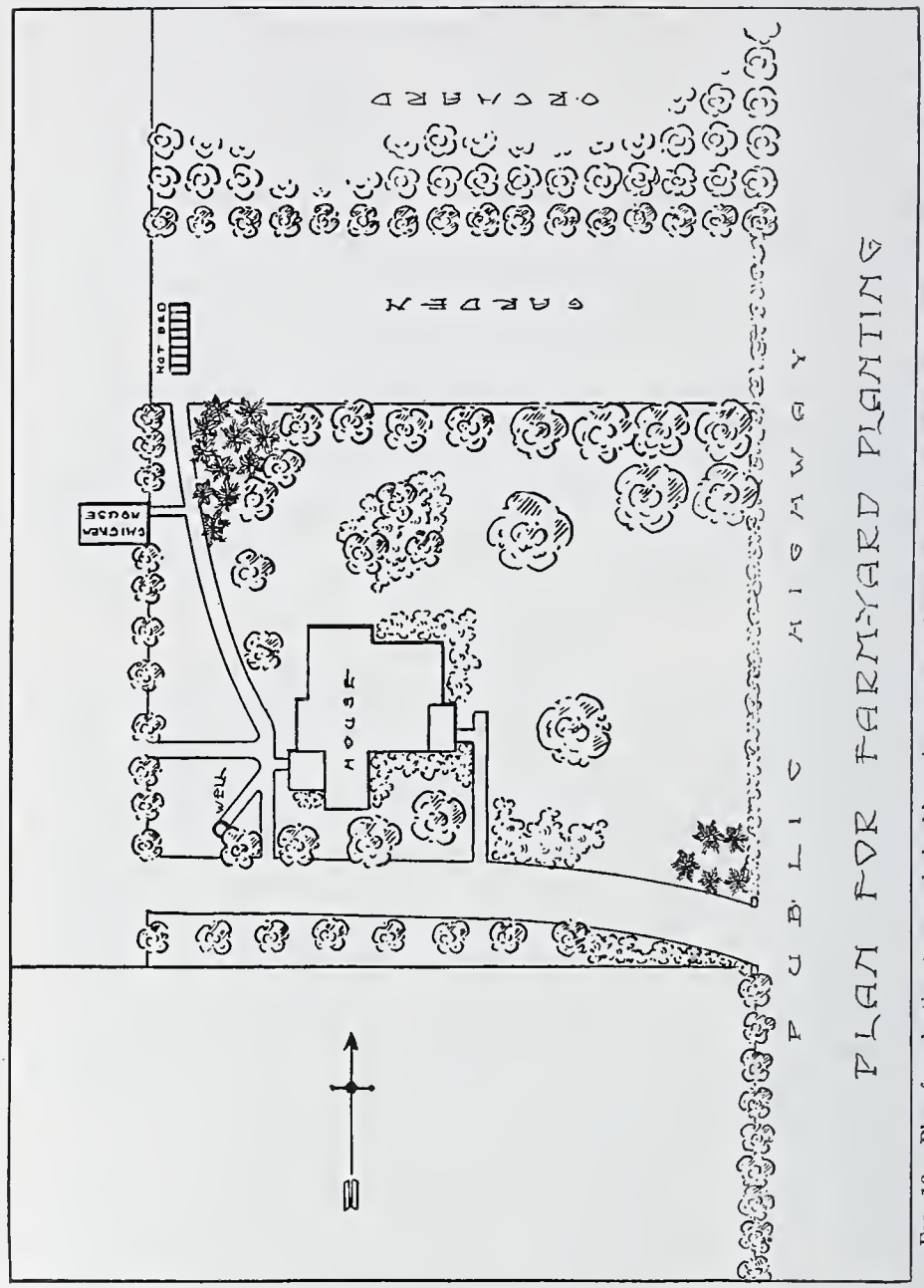


FIG. 12.—Plan for planting trees and shrubbery in a country home yard. The principal features in this plan are the arrangement of the trees so as to give the house protection during the heat of the day, the artistic arrangement of the shrubbery secluding the foundation walls, and the attractive clumps in the front yard. Another outstanding feature is the grouping of the trees along the north side of the yard with a clump of evergreens directly northwest of the house for winter protection. The evergreen hedge along the public highway is also a distinctive feature in this plan.

acter, is bound to be formal. Nothing adds more to the dignity of formality than uniformity, and, on the other hand, there is nothing that detracts from the beauty of formality more than the lack of uniformity. All the trees on a street should be of the same species and of as nearly the same size and shape as possible. However, it is not desirable to plant the one species on every street. Such a planting would be objectionable for several reasons. A number of species is desirable. One species may be attacked by insects that defoliate

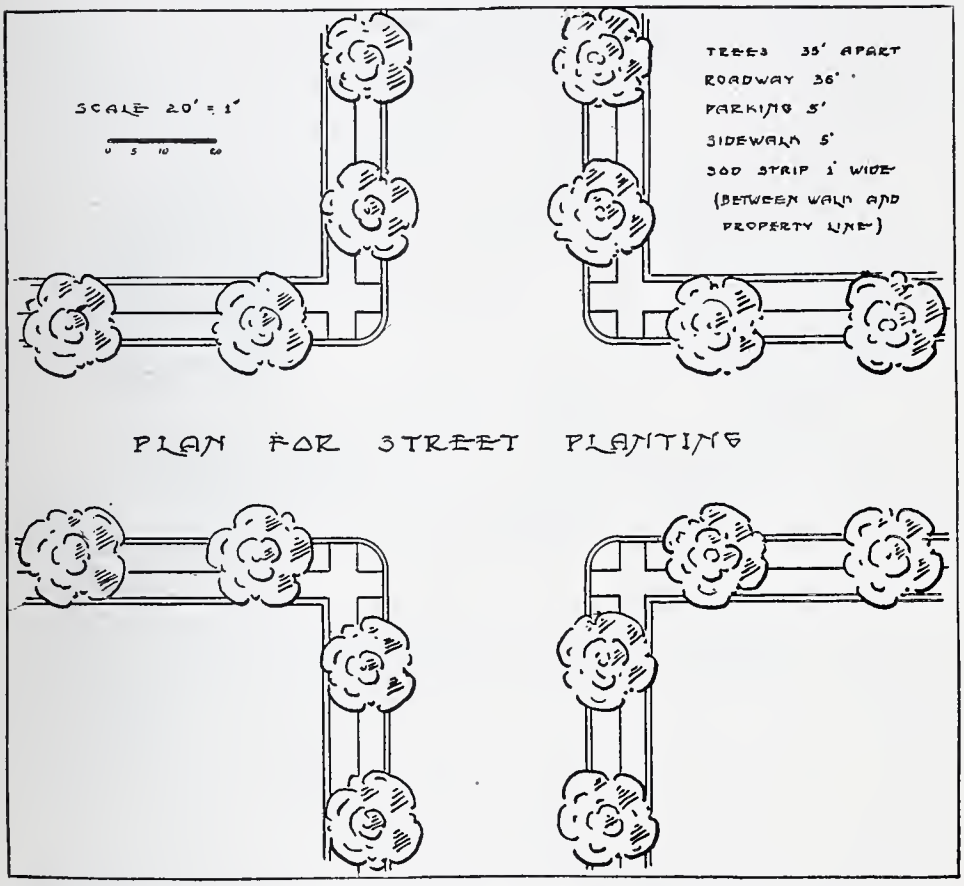


FIG. 13.—This plan provides for the proper location and spacing of street trees. Note the absence of trees on the corners, and the uniform placing.

or make unsightly webs; the others may be immune to them. One advantage of having the trees on any street of a single species is that in case of an insect attack the trees subject to attack are so grouped that they can be sprayed or otherwise treated at the least possible cost to prevent injury. The cost of labor is a large item in the care of street trees. Any satisfactory system of grouping the species so as to reduce to a minimum the labor required to care for them is desirable from the standpoint of economy.

Deciduous, broad-leaved trees are the most satisfactory for street planting. They give shade during the season in which it is needed. During the winter months the leaves are off and there is little obstruction to the direct light and

heat of the sun. On the other hand, evergreen trees cast a greater amount of shade during the winter months than they do during the summer months, and they are objectionable because they keep the streets and walks in an icy or muddy condition considerably longer than do the deciduous trees. Evergreens are, therefore, unsatisfactory as street or yard trees, both in summer and in winter. When a yard is large enough to permit ornamental planting, or the planting of a group of trees for a windbreak or to screen an objectionable view, the conifers may be used to advantage.

The selection of the species, the planting and the care of street trees are matters that should come under the jurisdiction of a municipal officer. When the planting is left to the property owners, each plants his favorite species or mixture of species, or, as often seems to be the case, each plants almost any tree he can get, regardless of its fitness or unfitness for the place. The trees are consequently planted at irregular distances, and often not in line with the trees on the adjoining lot. The result of such unsupervised planting is a mixture of all kinds, of all-sized trees, uneven spacing, trees out of alignment, and sometimes no trees at all for a considerable distance. Some trees are trimmed high; others are not trimmed at all, and the branches interfere with proper use of the sidewalks and streets.

Roadside Planting.

Roadside planting has not received as much attention in this state as the work merits. A well-kept row of trees along the roadside adds greatly to the general appearance of the adjacent farm, and it is pleasing to travelers when compared with the ordinary wire fence overgrown with weeds that separates the roadway from the field.

For roadside planting only the very hardy, drought-resistant and wind-firm species should be used. For best effect the trees along the roadside should be all of the same species and as nearly uniform in size and shape as possible. They should be spaced not closer than 40 feet apart, and they should be in rows, following the boundary fence. Uniform spacing and alignment add greatly to appearance. This distance provides ample room for full development of the trees without crowding or interfering one with the other. The object of roadside planting is largely for the purpose of beautifying the appearance of the adjoining farm. To accomplish this purpose the trees must be spaced widely enough to allow advantageous views of the farm from the road. Trees set 40 feet apart or farther do not seriously interfere with growing crops. Closely spaced trees along a roadside are objectionable for the reason that they exclude a view of the farm from the road, and also interfere with growing crops up to the fence line. When a windbreak is desired these points must be sacrificed, and several rows of trees should be planted as closely as the conditions will permit.

LOCATION OF ROADSIDE TREES.

The proper location for roadside trees is a point that is not easily determined. The travel on the road must in no way be inconvenienced. The telephone lines are a necessity, and they must be located on the public highway,

but they should not be allowed to restrict the improvement of or the convenience or pleasure of traveling. Shade trees along the roadside contribute greatly to the pleasure and comfort of travel, and therefore have a legitimate place along every highway. The accompanying sketch shows a convenient location for trees and telephone lines where the width of the road will permit such an arrangement. (See sketch.)

Even with this arrangement, the trees and telephone lines will interfere somewhat until the trees reach a sufficient height to clear themselves of the wires. In this diagram, poles that extend 18 feet above the ground are provided for. It may be found altogether convenient to use shorter poles. The convenience of this plan commends its adoption where the width of the roadway will permit its use.

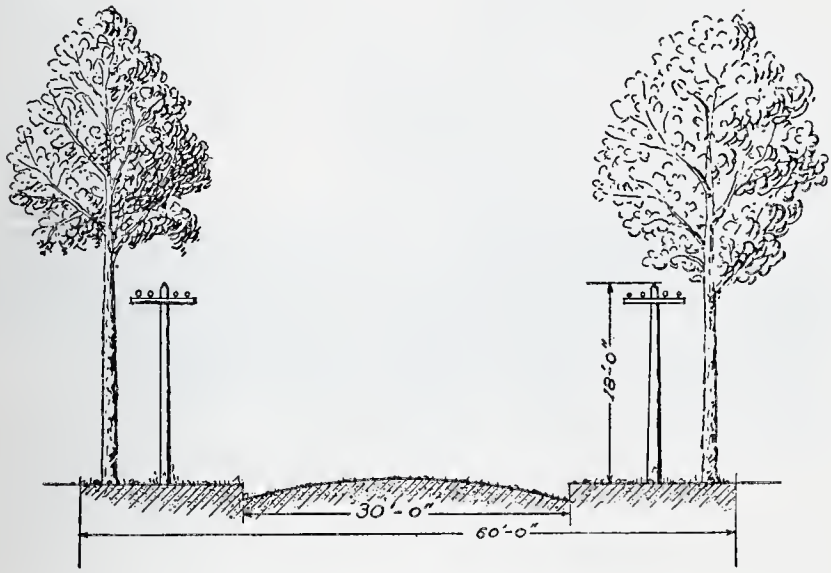


FIG. 14.—Sketch showing the location of roadside trees in the public highway, and the location of telephone poles in relation to the roadway.

Landscape Planting.

Landscape planting involves the planting of large trees. The methods of handling and planting these are very different than the handling and planting of nursery stock. The methods used in such work varies with the kinds of trees that are being planted. Broad-leaved trees can be handled more easily than the conifers or evergreen trees. Their roots are not so sensitive to exposure to the air, but they must be protected from drying. This may be done by keeping them covered with moist straw or moistened burlap, while they are out of the ground.

The roots of the conifers, or evergreens, are very sensitive to exposure to the air, and it is impractical to attempt transplanting them except with a considerable amount of their own soil adhering to their roots. This is best accomplished by digging the trees with a ball of undisturbed soil adhering to the roots. The size of the ball of earth necessary to insure the life of the tree will depend on the size of the tree. Evergreen trees 2½ feet in height should

have from 50 to 60 pounds of soil. This would be a ball of earth about 14 or 15 inches in diameter. Trees larger than this should never be transplanted except with balls of soil on their roots. Trees from 6 to 8 feet in height should have at least 150 or 200 pounds of soil adhering.

Special precaution must be taken in digging the trees to cut the balls as nearly round as possible, so as to guard against their breaking down and in order to allow handling the trees without breaking the balls of earth a burlap wrapper is usually securely and tightly pinned about them. If the soil in which the trees have grown is a heavy clay, there is very little danger of the balls breaking. On the other hand sandy soil breaks down very readily and is difficult to handle even when tied in burlap.

FIG. 15.—Moving pine trees on the Kansas State Agricultural College campus, in the winter. The larger tree is about 14 feet in height and has a ball of frozen soil on its roots that weighs more than two tons. This amount of soil is necessary to protect the roots from exposure to the air.

The accompanying illustration shows a pine tree more than 12 feet in height being moved in the winter. This tree has a ball of more than two tons of earth on its roots. After this tree was dug it was allowed to stand undisturbed until a crust was frozen to a thickness of about 2 inches. It was then handled with perfect safety. The trees shown here were moved nearly a mile on the skids. When large trees are to be moved greater distances than is practical to take them by skids, they are loaded on auto trucks or railway cars with derricks. Necessary precaution must always be taken to avoid danger of the balls of earth breaking under their own weight or from the result of handling.

When properly planted and cared for afterward, there is very little danger of such trees failing to grow.

ANNOTATED LIST OF TREES.

The trees discussed under this heading are:

Ginkgo.
White pine.
Jack pine.
Austrian or black pine.
Scotch pine.
Western yellow pine.
Swiss mountain pine.
Douglas fir.
Red cedar.
Chinese arbor vitæ.
White cedar.
Bald cypress.
Colorado blue spruce.
White fir.
Tulip tree.
Papaw.
Sassafras.
Basswood.
Hackberry.
American elm.
Chinese elm.
Osage orange.
Red mulberry.
Russian mulberry.
Prickly ash.
Hop tree, wafer ash.
Tree of heaven.
Willows.
Cottonwood.
White poplar.
Lombardy poplar.
Gum elastic or chittam wood.
Persimmon.
The ashes.
Catalpa.
Service berry.
Crabapple.
Hawthorn or thornapple.
Plums and cherries.
Redbud.
Honey locust.
Kentucky coffee tree.
Pagoda tree.
Yellow wood.
Black locust.
Sweet gum.
Sycamore.
Russian olive.
Soapberry.
Ohio buckeye.
The maples.
Black walnut.
The hickories.
Hop hornbeam or ironwood.
River birch.
The oaks.
The dogwoods.
Button bush.
Elderberry.
Viburnums.

In the following the species are taken up from the standpoint of general distribution, habitat, utility, æsthetic appeal, strong and weak points and method of propagation or reproduction, leaving the points of botanical characterization to Part II.

Ginkgo.

(*Ginkgo biloba.*)

This tree was introduced from China a number of years ago. It grows very successfully throughout the eastern half of the United States and extending north to about Philadelphia or New York. There are numerous specimens to be found in Kansas, mostly in city parks. In the eastern third of the state it has made a very successful growth, but it cannot be recommended for general planting throughout the state. In general appearance it is a very pleasing tree. It is symmetrical in outline and the leaves are strikingly different than the leaves of any of our American trees. It should be used for specimen planting throughout the eastern third of the state only. It is propagated entirely from seed. The seedlings should be grown in the nursery until they are of desirable size to be set out in their permanent location.

White Pine.

(*Pinus strobus.*)

The white pine was without doubt the most valuable of our American pines. It was the lumber tree of our early history, and the tree that developed the lumber industry of the United States. Eastern Pennsylvania, New York and the New England States were originally covered with white pine. The wood

FIG. 16.—This is probably one of the largest white pines growing in Kansas. It is 65 feet in height and its stem is approximately 3 feet in diameter. The white pine is very susceptible to wind influence, which is well illustrated in this picture. Note the undeveloped branches on the left side, which is toward the south. (*By Scott.*)

is soft, straight-grained, clear of defect and easily worked. The wood was used for every conceivable purpose and answered every need of the early settler and home builder that wood could supply. Its natural range of distribution extends west through Michigan, Wisconsin and Minnesota. It is a tree that requires a cool, moist soil and a humid climate. It can be classed as

only half-hardy in Kansas. The summer droughts and arid atmosphere are the limiting factors to its successful growth in this state. There are, however, some beautiful specimen trees of white pine growing in the eastern section of the state, notably in the vicinity of Leavenworth, Lawrence and Topeka.

The white pine is recommended for planting as specimen trees in the eastern third of the state. It is a tree that is pleasing in appearance in every particular and should be planted more extensively where conditions and soil favor its growth.

Jack Pine.

(*Pinus banksiana.*)

The jack pine is a small-sized tree found extensively throughout the barren, sandy regions of Minnesota and extending in northwesterly direction across Canada to the Arctic region. At its best it is of minor importance as a commercial tree because of its small size and the soft, perishable nature of the wood. The chief value of the jack pine lies in its adaptability to grow successfully on dry, waste, sandy land. It is only on such soils that it should be considered as a desirable tree to plant, except for its use as an additional species in parks or arboretums.

It is a tree of rapid growth, frequently making a height growth of 18 to 24 inches per year. It may be used successfully for windbreak or shelter-belt planting on very sandy land on which it is practically impossible to grow other species. This species has been used extensively by the Forest Service, United States Department of Agriculture, in the reforestation of the sand hills of Nebraska, where it has made a wonderful growth. Thousands of acres of sand hills that were practically barren 25 years ago are to-day a dense forest. The general aspect of the community has been changed from shifting sand hills to a stable forest. Even the bird life has undergone a change. Birds that live and nest in trees now inhabit the community. These were unknown prior to the establishment of the groves of pine trees.

This tree is well suited for windbreak and shelter-belt plantings throughout the state where sandy soils abound.

The Austrian or Black Pine.

(*Pinus nigra* and *Pinus nigra austriaca.*)

This is a European species that was introduced into this country years ago. It grows successfully from the Atlantic coast west to the Rocky Mountains. It has been planted throughout the entire state for ornamental purposes. It is entirely hardy and well suited for Kansas conditions. It is a strong, vigorous grower, pleasing in appearance at all times, free from any seriously injurious insect or fungus attacks.

It prefers a good fertile soil with a liberal supply of moisture, but grows satisfactorily under less favorable conditions. It is a tree that should be used generously in all kinds of plantings within the state.

Scotch Pine.

(*Pinus sylvestris.*)

The Scotch pine is a European species that was brought to America by the English. It proved to be a remarkably hardy tree in the New England States and was brought westward with the trend of civilization, and has proven well

FIG. 17.—An Austrian or black pine as it grows in the open. A strong, vigorously growing tree, approximately forty years of age. (*By Bumgardner.*)

adapted to the varying soil and climatic conditions at least as far west as the Rocky Mountain region. In Kansas it has proven to be one of the hardiest of our conifers and has been planted very commonly in parks, cemeteries and

home grounds throughout the state. It is a tree that survives transplanting quite readily, makes a rapid growth and is very pleasing in appearance. There are many trees of this species in the state that are 50 or 60 years of age, and are apparently in full vigor. This indicates that the Scotch pine is a tree of comparatively long life in this region. It is very free from diseases or serious insect injury. Inasmuch as it has withstood successfully the climatic hardships of the past, it is a safe and worthy tree to use for decorative and shelter-belt plantings.

FIG. 18.—A Scotch pine growing in the open. A widely spreading tree with somewhat scant foliage. (*By Scott.*)

Western Yellow Pine.

(*Pinus ponderosa.*)

The western yellow pine is a tree of wide distribution throughout the Rocky Mountain region. Its eastern limits of natural growth are found in the Pine Ridge section of Nebraska and the Black Hills of South Dakota. It is one of the largest of the American pines and reaches its best development and greatest perfection in Arizona, where it attains a height of 100 feet or more and a diameter of 8 feet or more. It is a hard, heavy, coarse wood that is used for all kinds of structural purposes.

The western yellow pine is a perfectly hardy tree in Kansas and deserves a place in every park in the state. Throughout the western half of the state it should be used for shelter-belt planting. One of the commendable features of this species is its longevity. Throughout its natural range it attains the ripe old age of 250 to 300 years.

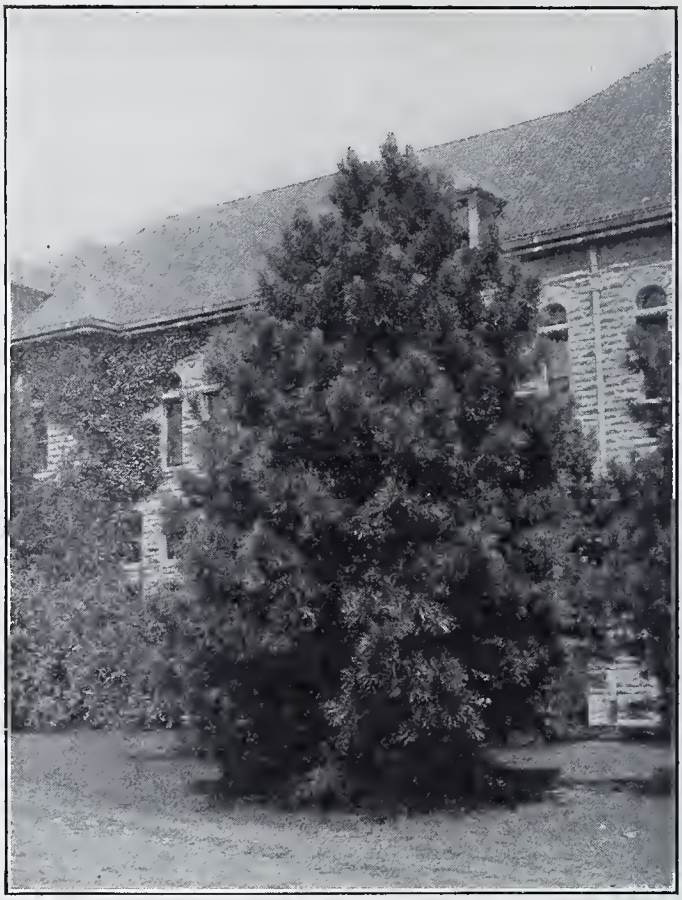


FIG. 19.—A western yellow pine on the Kansas State Agricultural College campus. A young tree that is making a vigorous, thrifty growth. The western yellow pine is one of the very promising pines for Kansas plantings. It is perfectly hardy under our conditions. The density of its foliage is of great value for protection from winds. (*By Scott.*)

Mugho or Swiss Mountain Pine.

(*Pinus mugo mughus.*)

This is a dwarf pine tree that seldom exceeds 12 feet in height. It has proven its hardiness throughout the length and breadth of the state. It is a tree that should be used in all parks and private grounds where a small-sized evergreen tree can be used advantageously.

Douglas Fir.

(*Pseudotsuga taxifolia.*)

The Douglas fir is decidedly a western species. It is found growing in the Rocky mountains, but attains its perfection in Washington and Oregon, where it attains heights of 150 to 200 feet or more, and diameters varying from 8 to 12 feet. The wood of the Douglas fir is soft, strong and durable. It is used for practically every purpose for which lumber is used.

FIG. 20.—A Douglas fir as it grows in the open. This tree is approximately 40 years of age and is about 45 feet in height. (*By Scott.*)

In Kansas the Douglas fir has been planted only as specimen trees in landscape plantings. Its successful growth in many parts of the state shows that it is a safe tree to use for such purposes. Throughout its youth it is a handsome tree, beautiful in outline and foliage, clean and free of diseases or insect attacks. With the approach of maturity it takes on a stately appearance. It is a long-lived species and should be given more consideration for park and cemetery plantings than it has received in the past.

FIG. 21.—A clump of red cedars growing in an open location. Note the dense growth of limbs from the ground to the tops of the trees. The tallest of these trees is about 35 feet in height. The red cedar is one of our best trees for windbreaks and ornamental planting. (*By Scott.*)

FIG. 22.—Red cedars used as a hedge. This hedge is about 20 years of age and is kept sheared to a uniform height of 4½ feet. Two shearings a year are necessary to keep it in good form. (*By Scott.*)

Red Cedar.

(*Juniperus virginiana.*)

The red cedar is the only evergreen that is found growing naturally within the state. It is the hardiest of any of our native trees. It will grow quite successfully on almost any type of soil found within the state. However, it prefers a fresh limestone soil. In such soil it makes a wonderfully rapid growth, frequently exceeding 18 inches a year in height.

The heart wood of the red cedar is reddish pink or brown in color, very light in weight, and very durable in contact with the soil or in use in exposed situations. The special uses of the red cedar wood is in the manufacture of

FIG. 23.—Red cedars used as street trees in the Manhattan cemetery. These trees are approximately forty years of age and are kept sheared to a uniform height and shape. Two shearings a year keep them in good form. These trees are about 8 feet in height. (*By Scott.*)

lead pencils and cedar chests. It is, however, used in many other ways in the commercial world. As a tree it is one of the most useful and desirable for all kinds of plantings. Its hardiness, and the vigor with which it grows, its adaptability to various types of soil, and its ability to recover from the ravages of grasshoppers and the destruction of hailstorms make it one of the very best trees for western Kansas conditions. The native cedar trees of Kansas have been used more extensively for fence posts and poles than for any other single purpose. The lifetime of a red cedar fence post is exceeded only by the Osage orange. The wood of the red cedar is short-grained and the posts under severe strain break at the surface of the ground when the ground is frozen.

The red cedar lends itself more readily to artificial treatment than any other tree that can be grown successfully in Kansas. Because of this fact it can be sheared and developed to any particular form. The more frequently the specimen is sheared the denser the surface of the tree becomes. It is one of our very best trees for ornamental hedges. When taken in time the trees can

be cut to any desired height, and by continued and systematic shearings a hedge of unsurpassed density and beauty can easily be developed. For windbreak or shelter-belt plantings in Kansas, the red cedar is by all odds the most valuable and satisfactory tree. It is a long-lived species throughout the United States, and it is a native in every state in the Union. In Kansas the red cedar is known to attain more than 150 years of age.

There is but one word of caution that should be given in connection with

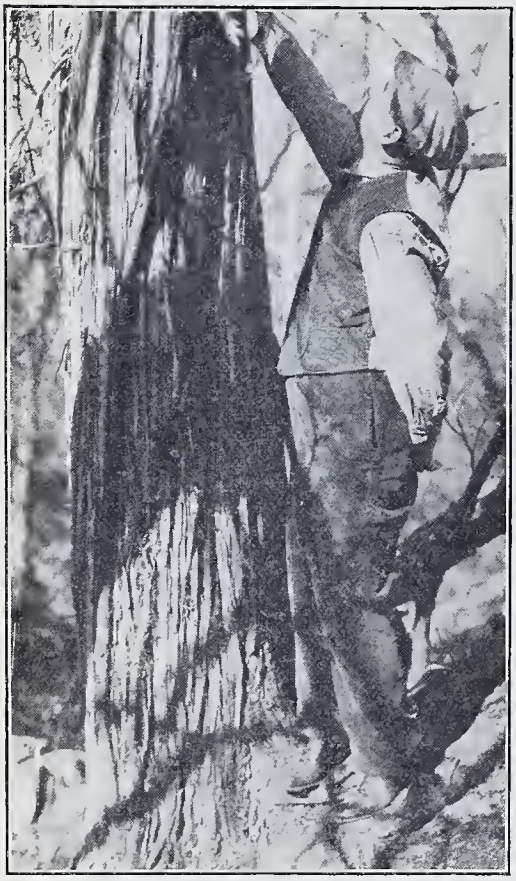


FIG. 24.—A portion of a stem of a red cedar growing near Westmoreland, Kan. This tree is not less than 250 years of age. This is probably one of the largest red cedar trees in Kansas. (*By Dickens.*)

The same red cedar. (*By Gates.*)

the red cedar. It should not be planted adjacent to an apple orchard. It is a host to the fungus known commonly as the *"red cedar apple."* Certain varieties of apples are also hosts to this fungus, and when the red cedar trees are growing near the apple trees the fungus is very difficult to control and the apples suffer from attacks of the fungus in the form of rust on the leaves and as scab on the fruit.

In the limestone sections of the state the red cedar is reproducing in great abundance and is extending its range over the land now occupied by broad-

leaved species as well as over the closely grazed pasture lands. Its favorite locations are steep hillsides, but it grows readily wherever grass fires are kept under control. It is very sensitive to fire injury, while on the other hand it is seldom injured by live stock, excepting when animals are restricted to limited range.

FIG. 25.—Reproduction of red cedar on an over-grazed hillside in Pottawatomie county, Kansas. Red cedar trees are rapidly reclaiming the eaten-out pastures throughout the hilly limestone sections of the state. Wherever vegetation is too sparse to carry fire the cedars thrive, but they cannot survive a fire. (*By Scott.*)

FIG. 26.—A hedge of red cedars. When planted 18 to 24 inches apart and kept sheared to desired height the red cedar makes one of the finest of evergreen hedges. The trees in this hedge are 8 years of age, and they have been kept sheared to 3 feet in height. (*By Scott.*)

The red cedar reproduces entirely by seed. Germination occurs only under favorable conditions. A cool moist soil is always desirable, and often the seed does not germinate until the second, third or even the fourth year after maturing. Birds are a very important factor in the distribution of the seeds.

FIG. 27.—A Chinese arbor vitæ. A fine ornamental specimen, about 8 feet in height and about 10 years of age. (*By Scott.*)

Chinese Arbor Vitæ.

(*Thuja orientalis.*)

The Chinese arbor vitæ was introduced from China some 30 or 40 years ago. In China it is a large-sized, long-lived tree, attaining heights varying from 90 to 120 feet and reaching diameters up to 10 or 12 feet. In some of the Chinese temple courts individual trees are known to be over 1,000 years of age. The wood is tough, strong and durable and is used for all purposes for which wood

is suitable. Its natural habitat is in the mountainous regions where the annual rainfall scarcely exceeds 20 to 25 inches, and where the minimum winter temperature falls to 18 to 24 below zero. One of the requirements of this species seems to be a dry winter atmosphere. It has proven a failure wherever tried in the United States where the winter humidity is great and where the minimum temperature falls to 10 or 15 degrees below zero.

The Chinese arbor vitæ has been grown in Kansas very successfully for the past 25 or 30 years. It adapts itself readily to most all types of soil found within the state. It is a tree of very pleasing appearance, and well adapted for all kinds of planting. It makes a splendid hedge when cut to proper height

FIG. 28.—Chinese arbor vitæ trees on the Kansas State Agricultural College campus. These trees are kept in this formal condition by shearing. Three shearings each summer are required to keep them looking as they are shown here. The arbor vitæ is one of the best trees to lend itself to artificial treatment. The oftener they are sheared the more dense they become. (*By Scott.*)

and kept sheared regularly. Beautiful specimen trees of almost any desired form may be found. The recognized forms, such as the *pyramidalis, globosus, compacta* and others, are propagated from cuttings taken from trees of desired form. Ordinarily the Chinese arbor vitæ is propagated from seeds. The seedlings are grown in the nursery until of suitable size for permanent planting.

This species is a valuable tree for all kinds of planting throughout the southern half of the state and southward throughout Oklahoma and Texas. It is not a satisfactory tree in the northern part of the state, especially in the extreme northwestern part. Its general use should be encouraged throughout its region of successful growth. It is a tree that is easily and successfully transplanted. It grows rapidly and gives general satisfaction in a greater measure than any other of the conifers, excepting the red cedar.

White Cedar.

(*Thuja occidentalis.*)

The white cedar is a tree that grows naturally in swampy situations throughout the northern and eastern states. On the most congenial sites in its natural range it attains a height of 60 to 80 feet. Often three or more trees grow from a single root. The trees sometimes grow to be 5 or 6 feet in diameter, but more commonly they are from 2 to 3 feet in diameter. The wood is soft, coarse-grained, and very durable. It is used extensively for telegraph and telephone poles, fence posts and railway ties.

Inasmuch as the white cedar requires a moist soil and a humid atmosphere for its successful growth, it cannot be recommended as a suitable species for planting in Kansas. Occasionally specimen trees of this species are found in parks and home yards in the eastern part of the state.

Bald Cypress.

(*Taxodium distichum.*)

The bald cypress is another swamp-type tree. Its natural range is throughout the Southern states. It frequently attains a height of 150 feet and

Fig. 29.—A bald cypress growing on the campus at the Kansas State Agricultural College, Manhattan. This tree is approximately 50 years of age and is a thrifty, vigorous specimen, approximately 50 feet in height. (*By Scott.*)

The same tree in winter. (*By Gates.*)

diameter up to as much as 12 feet, although more frequently it does not exceed 4 or 5 feet in diameter. The wood is brown in color, light in weight, soft, not strong. It is used extensively for finishing material, cooperage stock, posts and poles. The wood is very durable in contact with the soil and when used in exposed situations. Pecky cypress is used extensively in the construction of

greenhouses and other uses where durability under extremely trying conditions is required.

The bald cypress cannot be recommended for general planting in Kansas. It demands extremely moist or swampy soil and an abundance of atmospheric humidity. There are, however, some beautiful specimen trees of this species growing in the eastern third of the state. It is a tree that should be used in parks and home yards where its soil requirements can be provided.

FIG. 30.—The stem of a bald cypress showing characteristics of the bark. This stem is approximately 20 inches in diameter. (*By Scott.*)

Colorado Blue Spruce.

(*Picea pungens.*)

The Colorado blue spruce is conceded by all lovers of trees to be the most beautiful of our American evergreens. Its soft silvery blue-gray foliage of early spring is its most striking feature. This blue-gray color is held well throughout the summer and gradually changes to a deeper shade of green.

The Colorado blue spruce is found growing in its natural habitat throughout the mountainous regions of Colorado and Utah and in some parts of

Wyoming and possibly New Mexico. In favored localities it attains a height of 100 feet or more. It is a long-lived tree and well adapted to withstand the rigorous climate of its natural range.

Perhaps no other tree, unless it is the red cedar, succeeds under a greater range of climate than does the Colorado blue spruce. Because of its unsurpassed beauty, it has been planted on public grounds and private home yards in practically every state in the Union, as well as throughout Europe.

FIG. 31.—A Colorado blue spruce growing on the Kansas State Agricultural College campus, Manhattan. This tree is approximately 18 feet in height and is probably 30 years of age. (*By Scott.*)

It is a tree that transplants quite readily. It grows very slowly, seldom exceeding a few inches in height each year. This feature makes it a valuable ornamental tree for yard plantings. All of these features make it a highly desirable tree. There are very few parks or cemeteries within the state in which Colorado blue spruce are not to be found growing. It is a tree that should be in every park, cemetery, school yard and private home yard in the state. It gives added charm and dignity to every location.

This species reproduces naturally from seed under favorable conditions. The seedlings, however, make a very slow growth, seldom exceeding 1½ or 2

inches the first season. These small plants are very susceptible to fungus diseases and also suffer heavy loss from droughty conditions. By the end of the first summer a very small percentage of the plants that started in the spring have survived.

Koster's blue spruce that is listed by most evergreen nurseries is a select type of the Colorado blue spruce, the silvery blue-gray color being the highly prized feature. Shoots of choice specimen trees are grafted on seedling roots. This is a slow and tedious process of propagating trees, consequently the trees of this type are usually the highest priced stock listed.

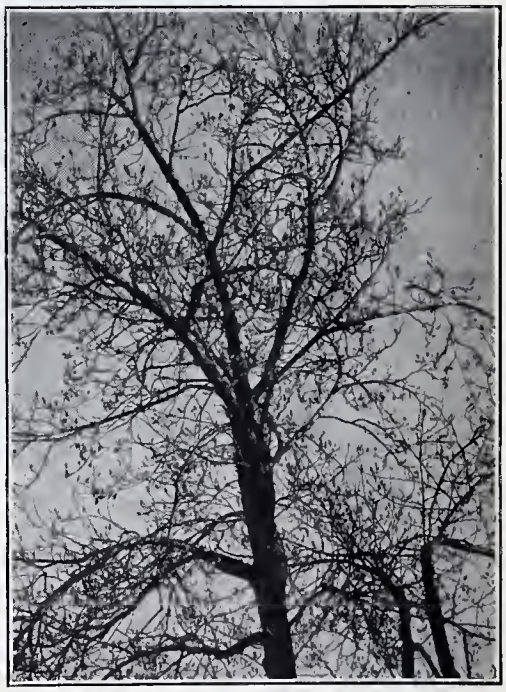
White Fir.

(*Abies concolor.*)

The white fir is a native of southern Colorado, New Mexico, Arizona and California. Like the Colorado blue spruce, its most characteristic feature is its blue-gray foliage of early spring. It is a tree of great beauty and dignity.

Under favorable conditions it lives to a great age and attains a height of 200 feet or more. It has been planted as an ornamental tree throughout the eastern states and also in Europe, where it grows more vigorously than any other of the firs. In Kansas it is not entirely hardy, and it cannot be recommended for general planting. Occasional specimens of this species may be found in parks or in home yards in the eastern third of the state. It is propagated entirely from seed.

FIG. 32.—A yellow poplar or tulip tree growing on the Kansas State Agricultural College campus, Manhattan. This tree is probably 60 years of age and is fully 60 feet in height. A beautiful specimen of the tulip tree as it grows in the open. (*By Scott.*)



A yellow poplar or tulip tree in winter. (*By Gates.*)

Yellow Poplar or Tulip Tree.

(*Liriodendron tulipifera.*)

The yellow poplar or tulip tree is a native of the Eastern and Southern states. It is found most abundantly in Ohio, Tennessee and Kentucky. In rich, deep, moist soils it attains a height of 200 feet with trunk diameters of 6 or 8 feet. In the deep woods the yellow poplar is a tall slender tree entirely free of branches for 30 or 40 feet. In the open it developes a wide spread of limbs from the ground up. The leaves are a deep green with glossy surface,

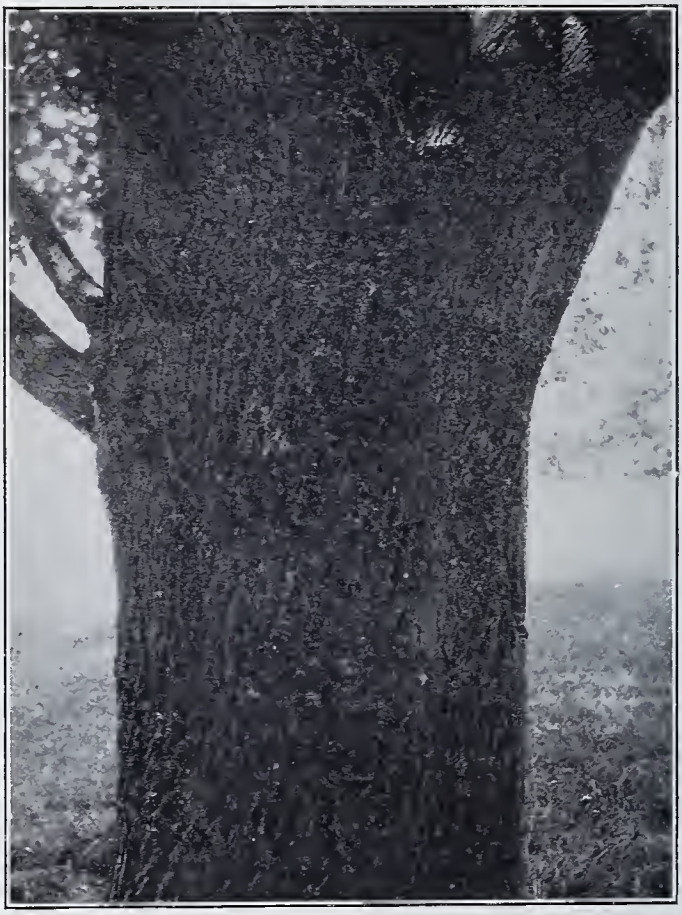


FIG. 33.—The stem of a tulip tree showing the characteristics of the bark. (*By Scott.*)

turning yellow in autumn. The flowers are yellowish with pink markings and resemble a tulip in form and size. It is from this feature of the tree that it derived its name, tulip tree. The name yellow poplar is derived from the color of the wood, which is yellowish or yellowish brown. The wood is soft, light, and easily worked, and is used for practically every conceivable purpose for which wood is serviceable.

It is a tree of great beauty and highly desirable for all kinds of plantings. However, it transplants with great difficulty and is not a tree that is well suited to the climatic conditions of Kansas. Specimen trees of this species may be seen in the parks and home yards in the eastern part of the state.

Papaw.

(*Asimina triloba.*)

The papaw is a small-sized tree seldom exceeding 30 feet in height or a foot in diameter. Its natural range of growth is from New Jersey west to eastern Nebraska and south to Texas. It grows in great abundance along many of the streams in eastern Kansas. It requires a deep, rich, cool soil and prefers the shade of larger trees to the open sunlight. It is a tree that is very difficult to transplant successfully.

FIG. 34.—Blossoms of the papaw.
(*By Gates.*)

The most striking feature of this tree is the large edible fruits, which are sometimes as much as 5 inches in length. When ripe the flesh is yellow, rich and sweet. The leaves are also quite large and suggestive of tropical vegetation.

Sassafras.

(*Sassafras sassafras.*)

The sassafras is a tree of wide range of distribution extending from eastern Kansas and Oklahoma to the New England states. It prefers a well-drained sandy soil. In favored locations it attains a height of 80 or 90 feet with diameters of 4 to 6 feet.

The striking features of this tree are its deeply lobed leaves, that are a deep green throughout the summer and rich in delicate shades of pink and

yellow in autumn, and the highly aromatic taste of the bark, which is used for medicinal purposes.

This is a highly desirable and satisfactory tree for yard and park plantings in eastern Kansas.

Basswood.

(*Tilia glabra.*)

The basswood is a tree of wide distribution extending from the St. Lawrence river westward and south to eastern Nebraska, Kansas, Oklahoma and Texas. It prefers a deep, cool, moist soil and its natural growth in Kansas is confined

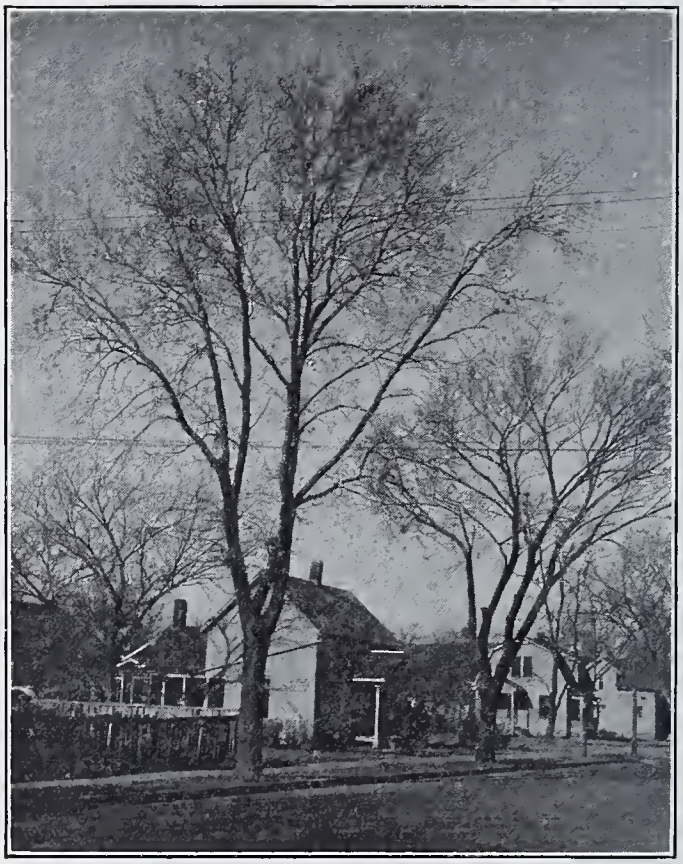


FIG. 35.—A hackberry tree about 60 feet in height. Stem diameter about 2 feet. This is a very characteristic form of this species. The clusters of small twigs are known as "witches' brooms," and are supposed to be caused by insects stinging the stems or possibly by fungi. (*By Scott.*)

to low ground along the streams of the eastern part of the state. It is a tree of much beauty. The foliage is a deep green throughout the summer, turning bright yellow in autumn. The blossoms appear in June in Kansas. Though inconspicuous they are rich in fragrance and yield large quantities of honey.

The basswood is frequently planted for street trees in our eastern cities. One of the avenues in Washington, D. C., is noted for its beautiful basswood trees. It is a tree that is often planted for a like purpose in Europe. It should be used more extensively in eastern Kansas.

Hackberry.

(*Celtis occidentalis.*)

The hackberry is another tree of wide natural range extending from the St. Lawrence river to the Dakotas, Nebraska, Kansas, Oklahoma and Texas. It is a tree that frequently attains a height of 100 feet or more and trunk diameters of 4 or 5 feet. It adapts itself to a wide range of soils and is, therefore, well adapted to all kinds of planting. In hardiness it ranks next to the white elm in Kansas. Its rate of growth is about the same as that of the

FIG. 36.—A stem of the hackberry (*Celtis occidentalis*) showing the bark characteristics. (*By Scott.*)

white elm. There is, however, this striking difference between the two species; the hackberry is a very straight-grained wood and splits very readily, and frequently the trees are severely injured by windstorms splitting off limbs or dividing the trunk, while the white elm is very cross-grained and almost impossible to split.

The wood of the hackberry is very perishable in contact with the soil. It burns readily and is a splendid fuel wood. It is subject to attacks by borers when used as lumber and is therefore unsatisfactory for construction purposes even in protected locations.

It is a tree that should be used extensively for street, roadside, yard and

park plantings. It transplants readily, withstands heat, drought and cold, and grows successfully on practically all types of soil. It is propagated entirely from seed. These may be planted either in the fall or spring.

American or White Elm.

(*Ulmus americana.*)

The American or white elm is one of the famed American trees. It grows naturally in every state east of the Rocky Mountains. Its western range of natural growth is along the headwaters of streams in western Oklahoma, Kansas, Nebraska and the Dakotas. It is one of the largest of the deciduous trees

FIG. 37.—A white elm in winter. This is one of the older trees in Topeka. (*By Bumgardner.*)

found growing in the Eastern states. It frequently attains a height of 90 to 125 feet with a trunk diameter of from 6 to 10 feet. It attains its greatest size and most perfect form in the New England states, and it is in those states that it has attained its greatest renown. In "The Autocrat of the Breakfast Table," Oliver Wendell Holmes described it as follows: "The American elm is tall, graceful, slender-sprayed and drooping as if in languor." Liberty elms were planted in Providence, Newport and New York at an early date. The Providence elm was dedicated to the "Sons of Liberty" on July 26, 1768. On July 3, 1775, George Washington assumed command of the Continental army under an elm at Cambridge, Mass. The "Treaty Tree" under which William Penn concluded a treaty with the Indians was an elm.

New Haven, Conn., is known as the "City of Elms," because of the many

stately elms that line her streets. On the White House grounds at Washington a noble elm is growing that was planted by John Quincy Adams, when he was president. This tree is now fully 100 years of age.

The American elm is one of our long-lived deciduous trees and it will under favorable conditions live to reach the ripe old age of 150 to 300 years.

The American elm has been planted in greater numbers in the United States for yard, street and roadside trees than any other single species. The commendable features of this tree are its longevity, hardiness and pleasing appearance. There are very few species of deciduous trees that live to reach a

FIG. 38.—A white elm. This is but a young tree, not more than 40 years of age, and has a spread of limbs of more than 60 feet. The white elm is used more than any other American tree for street and yard planting. (*By Scott.*)

greater age than that attained by the American elm. Its hardiness is at once recognized by its wide range of natural distribution and by the ease with which it adapts itself to successful growth in regions beyond its natural range. It grows in all types of soil favorable to tree growth and succeeds under a wide range of climatic conditions. It is comparatively free from serious insect pests. It is a clean tree of medium rate of growth, pleasing in form and appearance. When grown in the open it develops a broad spreading crown measuring from 75 to 150 feet across.

A striking characteristic of this tree is the toughness of its wood. The fiber is cross-grained and difficult to split. Hence the tree is able to withstand wind and sleet storms with little or no injury. It is seldom that an American elm is broken or blown down by a storm.

The wood is of medium weight, tough and strong. Very perishable in con-

tact with the soil or in exposure to the weather. It is, however, a very serviceable wood for interior structural work. In this state it is used extensively for barrel staves, box boards and fuel.

The American elm should be given first consideration for yard, street and roadside planting in Kansas. It will withstand more adverse soil and climatic

FIG. 39.—A Chinese elm in winter. This tree is growing on the Hays Branch Experiment Station grounds, Hays, Kan. It was 12 years of age at the time it was photographed. The stem is more than 12 inches in diameter and the tree is over 30 feet in height. (*By Aicher.*)

conditions and neglect than any other of our deciduous trees. When planted under favorable conditions and given proper care it will attain as great a degree of perfection in as short a time as any tree that can be grown in this state.

The American elm is propagated entirely from seed, which ripens in May and should be planted at once as they lose their vitality in a short time.

Chinese Elm.

(*Ulmus pumila.*)

The Chinese elm is a tree of recent introduction into the United States from China. It is, because of its hardiness and rapidity of growth throughout the plains region of the United States, worthy of the consideration of all tree planters. It has proven absolutely hardy at the experiment stations at Lubbock, Tex., Woodward, Okla., and Hays, Kan. The superintendents at each of these stations recognize it as one of the best trees, under their observation, for

FIG. 40.—The Chinese elm as a street tree in Manhattan. This tree is 6 years of age from seed. The stem is 8 inches in diameter and the tree is fully 24 feet in height. (*By Gates.*)

the needs of the regions in which they are located. A specimen of this species that was planted at Hays, Kan., in 1912, is the best type of its age on the experimental farm. It now measures 30 feet in height, more than a foot in diameter 3 feet above the ground, has a wide spread of limbs, and has never suffered from the effects of heat, cold or drought. It has had no special care to protect it from injury by existing weather conditions.

Mr. Chilcott, of the Woodward, Okla., station, reports the *Ulmus pumila* to be by all odds the most promising tree for western Oklahoma of any under his observation.

Judging from all sources from which information can be gathered, this is a valuable tree for western Kansas planting.

In its natural range in China it is a medium-sized tree, attaining a height of

60 to 70 feet and a diameter of 2 to 3 feet, and is used for general lumber purposes. The longevity and the size that it will attain in the United States is unknown as the trees that are now growing in this country are under 20 years of age and have not reached maturity.

The Chinese elm is very pleasing in appearance. The leaves are similar in form and structure to the leaves of the white elm, but they are only about one-fourth as large. The twigs are slender and drooping. The seedling and transplanted trees of this species grow much more rapidly in the nursery than the seedling and transplanted trees of the white elm.

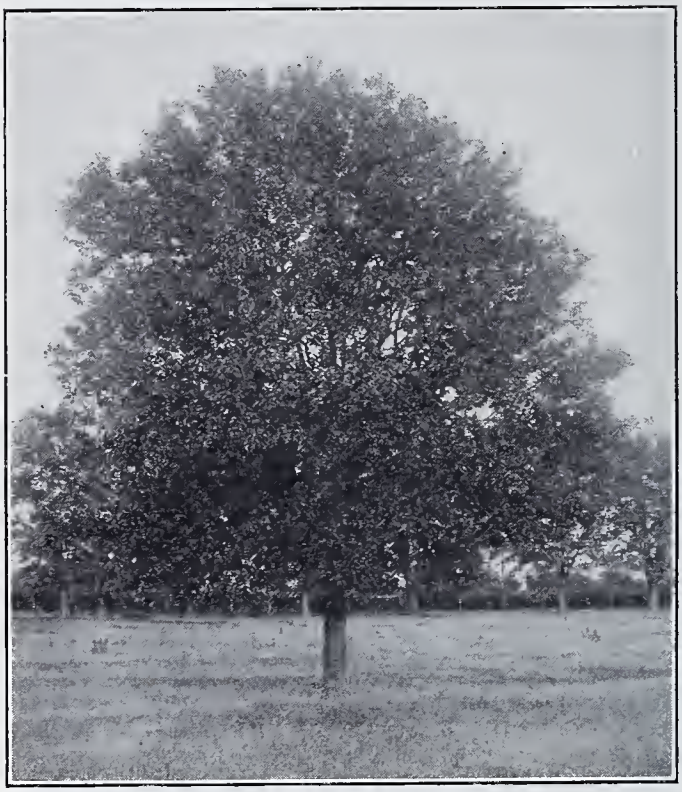


FIG. 41.—An Osage orange tree grown in a pasture near Lawrence, Kan. This tree is about 35 feet in height and the stem is 18 inches in diameter. An unusually fine specimen of this species. (*By Bumgardner.*)

Osage Orange.

(*Toxylon pomiferum.*)

The Osage orange, or "hedge," as it is commonly known in Kansas, is a small-sized tree seldom exceeding 35 feet in height or 18 inches in diameter.

The Osage orange is a southern tree. Its range of natural distribution is throughout southeastern Oklahoma and eastern Texas. It has been planted widely and generally throughout Kansas for hedges and in some instances in groves for fence-post production. The Osage orange has proven entirely hardy in this state. It succeeds on practically all types of soil, but prefers a fresh, moist soil. In this type of soil it makes a vigorous growth. In the

dry upland soils it makes a slow and unsatisfactory growth, but clings tenaciously to life.

The stems and branches of the Osage orange are armed with short, stout barbs with needlelike points, that repel man and beast. This feature makes it the most effective hedge that can be grown in the state.

The heart wood of the Osage orange is yellowish brown, very heavy, hard and exceedingly durable in contact with the soil. It is especially valuable for fence posts and fuel wood. As posts it lasts indefinitely. As fuel wood it burns very readily either green or dry and gives a quick, hot fire.

FIG. 42.—A Russian mulberry about 30 feet in height with a spread of limbs that fully equals its height. Trees of this species provide deep shade and shelter to live stock during summer months. (*By Scott.*)

Russian Mulberry.

(*Morus alba.*)

The Russian mulberry has been planted very generally throughout Kansas for hedges, and also as street and yard trees. Its hardiness is well established and it is recognized as a suitable tree for shade and shelter to man and beast. It makes its best growth in the Arkansas river valley, where it attains a height of 40 feet with trunk diameters of 2 to 3 feet. On the high prairie lands of western Kansas it makes an unsatisfactory growth, seldom exceeding 10 feet in height. The wood of the Russian mulberry is hard, heavy and very durable in contact with the soil. It is used extensively for fence posts and fuel wood and is well suited for each of these purposes. The fruit of the Russian mulberry may be either purple or white when ripe. The color of the ripe fruit varies with the individual tree. Although edible, the fruit is seldom used for human food. Birds are very fond of the ripe berries, and mulberry trees are frequently planted near cherry orchards, raspberry and blackberry patches, in order that the birds may feed on the ripe mulberries in preference to the other fruit. The mulberries ripen very irregularly and

ripe fruit may be found on the trees from the latter part of May until the middle of July. The objectionable feature of the mulberry is that its fruit stains any object with which it comes in contact. On this account the trees should not be planted where the ripe fruit will fall on the sidewalk, or the yard where children play, or over clotheslines.

The ripe fruit attracts large numbers of flies, and the tree is therefore objectionable for the yard.

The merits of the tree are: It makes a rapid growth on favorable soils, has very dense foliage and provides an abundance of shade and shelter to live stock, and an unlimited supply of food for birds while a living tree, and the wood makes excellent fence posts and fuel. It should be planted for these purposes.

Ailanthus—Tree of Heaven.

(*Ailanthus altissima.*)

The ailanthus is an introduced tree that has adapted itself to eastern Kansas conditions. The seeds from the early planted trees were carried by the wind to unoccupied locations where they struck root and soon occupied the

FIG. 43.—An ailanthus tree in bearing. Clusters of seeds and not leaves cover this tree. (*By Gates.*)

ground to the exclusion of other vegetation. In favored locations it has attained a height of 60 feet with trunks measuring 24 to 30 inches in diameter. The wood is very hard and heavy. It is very perishable in contact with the soil. It is exceedingly difficult to season, but burns readily in the green state. Its only value is for fuel wood. It grows successfully only in rich, moist soils where more valuable trees grow equally as well. The one commendable fea-

ture of this tree is its ability to grow in cities where the smoke, gases and grime are fatal to other trees. The writer has seen this species growing in the alleys of tenement districts of New York where it was the only tree or shrub of any description that was growing thriftily.

Red Mulberry.

(*Morus rubra.*)

The red mulberry is a small-sized tree seldom exceeding 60 feet in height or 2½ feet in diameter. The wood is coarse-grained, tough, and very durable in contact with the soil. It is a splendid fence-post and fuel wood.

It is very fastidious regarding its soil requirement. It succeeds only on rich, moist soils. It prefers the protection of other trees to the direct exposure to the sun and wind.

The red mulberry is not a tree that can be recommended for general planting in Kansas. It is propagated from seeds only.

Prickly Ash.

(*Zanthoxylum americanum.*)

The prickly ash is a mere shrub or small tree of no economic worth in Kansas. It is made use of to some extent in a medicinal way, and as a native woody species of this state it deserves mention. Its range of distribution in Kansas is confined to the eastern third of the state.

Hop Tree or Wafer Ash.

(*Ptelea trifoliata.*)

The hop tree is a small-sized tree seldom exceeding 20 feet in height, and its natural range of distribution in Kansas is confined to the extreme southeastern part of the state. It is of no economic worth, but deserves mention as a native woody species.

Willows.

(*Salix.*)

There are at least five species of willows found growing naturally in Kansas. Of these there is but one that attains a sizable tree—the *Salix nigra* or black willow. This species grows to a height of 30 to 40 feet with a diameter of 2 to 3 feet. Its favorite location is along watercourses. It requires an abundance of soil moisture and prefers a sandy or light alluvial soil. It is found most abundantly in the eastern part of the state, but it follows the watercourses well into the western end.

The wood is soft, light, perishable in contact with the soil, and of very little value as fuel wood.

Numerous varieties of willows have been brought into the state and planted for ornamental purposes. Of these the Wisconsin weeping willow is perhaps the most common and can easily be recognized from the other species by its long, slender, drooping branches that sweep the ground. The flexibility of the branches gives the weeping willow a charm that few trees possess.

The willows are northern trees and like a cool soil supplied with an abun-

dance of moisture. They are among the first trees to come into leaf and blossom in the spring, and are therefore a source of delight in every park.

The pussy willow catkins are the most showy of all the early tree blossoms. They appear in February and early March and are used by florists as cut flowers.

The willows are of no economic value in Kansas as a source of timber supply. They are used in great numbers for riprapping the banks of rivers to

FIG. 44.—Black willows growing in a pasture in a ravine, Jefferson county. It is very characteristic of the black willows to grow in such locations. They provide an abundance of shade for live stock. The trampling of the ground above their roots by cattle and horses apparently is not detrimental to the trees. *(By Scott.)*

prevent the water washing away the soil. On low overflow land they serve as a soil builder, checking the current of flood waters and retaining the sediment that is deposited from time to time.

Throughout Iowa and southern Minnesota the willows have been planted extensively for windbreaks to shelter farmsteads.

The willows reproduce naturally from seeds and by natural cuttings, which are twigs broken off by wind or sleet and find lodgment in favorable locations to strike root. In commercial nurseries they are propagated entirely from cuttings.

FIG. 45.—A lone black willow growing beside a gully in a pasture. Willows require an abundance of soil moisture and their favorite location is along ravines where flood waters soak the ground or along streams where their roots reach out to a continuous supply of moisture. (*By Scott.*)

The Cottonwood.

(*Populus deltoides* and *P. sargentii.*)

This tree can rightfully be called the "Pioneer Tree of Kansas." It was the cottonwood that gave the first shade and shelter to the early homesteaders of central and western Kansas. If the full truth were known it might honestly be said that the successful growth of the cottonwood grove on the homestead was often the determining factor in the decision of the homesteader to "stick it out until he could prove up on his claim."

The cottonwood might also be called the "Kansas Eucalyptus," for it grows more rapidly than any other of our native species. Under favorable conditions it makes a height growth of 6 to 12 feet per year, and an increase in diameter of fully an inch or more. It is a tree that attains a height of 80 or 90 feet with a clear trunk of 30 feet or more, and a diameter of 6 to 8 feet at the base.

The cottonwood is a tree of wide range of natural growth. It grows in all the states east of the Rocky Mountains. It is a tree that adapts itself to a variety of soil conditions. It makes its best growth on deep, rich, well-drained loam soils, but it also grows with remarkable rapidity on sand bars and along the sandy river channels throughout the state. It even thrives on strongly alkaline soils, but it does not make the clear growth that it found on the fresher soils.

From the standpoint of lumber production there is not another tree that is adapted to growing in this state that will produce as great a yield of lumber in board feet as the cottonwood. Along creek or river channels, on overflow land suitable only for the production of timber crops, it is safe to estimate a yield of 12,000 to 15,000 board feet per acre from a full stand of cottonwoods at 25 to 30 years of age.

The cottonwood lumber is well suited for interior building purposes. For

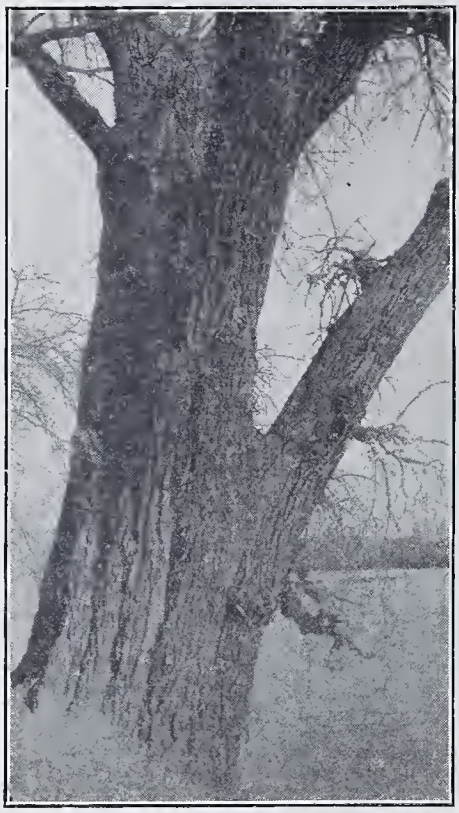


FIG. 46.—The stem of a rugged old cottonwood growing on the bank of the Kansas river near Manhattan. The stem of this tree is more than 8 feet in diameter. Note the comparison of the size of this tree with that of the man scaling it. The tree is 90 feet in height. (*By Gates.*)

the framing, flooring and partitions in barns the cottonwood is superior in many ways to the pine and fir lumber that is on the market. Not only is cottonwood lumber valuable for farm building purposes, but it also has a very important place in the lumber trade. Cottonwood staves are the best staves available for flour barrels. The lumber is in great demand for chicken crates, egg crates, fruit and vegetable boxes.

Because of the hardiness of the cottonwood and the ease with which it can be grown, there are more groves of cottonwood trees throughout central Kansas, than of any other species. These were planted by the early settlers, 30 to 50 years ago, during the life of the "timber-claim act." The trees in these groves are reaching maturity and many have been cut and sawed into lumber.

FIG. 47.—A Kansas cottonwood. One of the largest as well as one of the oldest trees on the Kansas State Agricultural College campus, Manhattan. (*By Scott.*)

The cottonwood is an easy tree to propagate. The seedlings can usually be found by the thousands along any creek or river channel. At 1 or 2 years of age these are of suitable size for planting. If seedlings are not available, the trees can be readily grown from cuttings. These when planted in fresh, moist soil strike root readily and make from 4 to 6 feet of growth the first season. An acre or two of waste land, if planted to cottonwoods, will in a few years yield a surprising quantity of saw material.

FIG. 48.—This cottonwood is probably one of the oldest now growing on the Kansas State Agricultural College campus, Manhattan. It is about 70 feet in height, and its stem is fully four feet in diameter. (*By Scott.*)

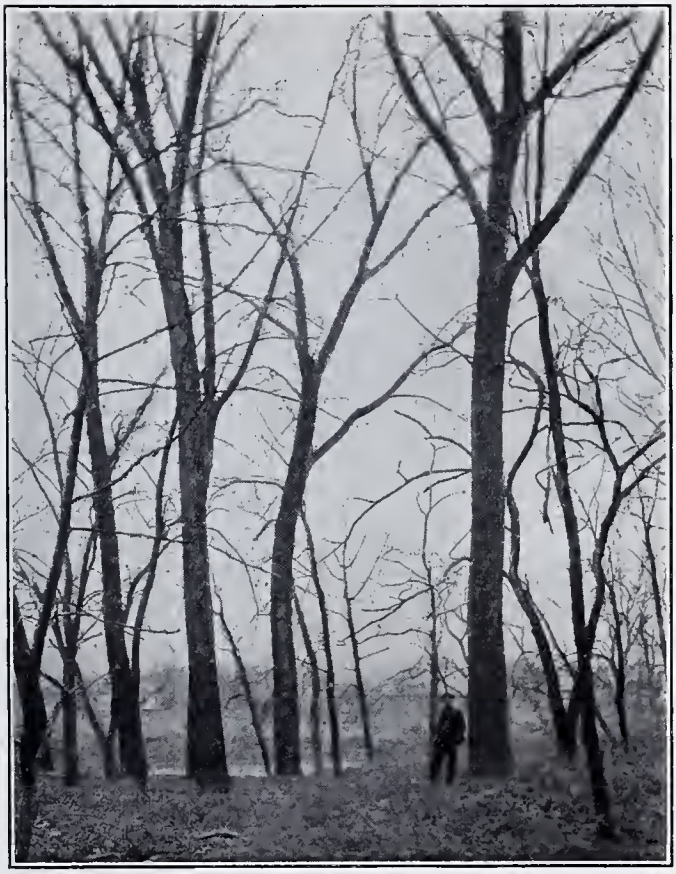


FIG. 49.—Cottonwoods, the three larger trees in this picture, growing in mixture with other trees along the Blue river. Note the long clear length of the stems. The right form and a good size to cut into lumber. (*By Scott.*)

White Poplar.

(*Populus alba.*)

The white poplar is a European species that was brought to Kansas some 40 or 50 years ago, and may be known erroneously as "silver maple." It is a tree of rapid growth and pleasing appearance. The white, cottony covering of the under surface of the leaves is a striking contrast to the dark green or almost black upper surface. It is a short-lived tree at the best, of no economic value, excepting for shade and ornamental purposes. One objectionable feature of this tree is that it sprouts freely from roots near the surface. If growing on otherwise unoccupied land, these root sprouts soon form a dense thicket. In home yards this feature is very objectionable.

FIG. 50.—The large tree in this picture is a "white poplar," a splendid specimen of this species, growing in Lawrence, Kan. (*By Bumgardner.*)

Gum Elastic or Chittam Wood.

(*Bumelia lanuginosa.*)

The gum elastic is a small-sized tree in Kansas, seldom exceeding 20 feet in height or a foot in diameter. The branches are usually armed with slightly curved spines. The tree to some extent resembles the Osage orange. The leaves, however, are much smaller and of a dull green color. The wood is heavy,

hard, not strong, light brown or yellow in color, and of no economic value. This species is found only in the extreme southern part of the state. It prefers a rather dry, well-drained soil.

Lombardy Poplar.

(*Populus nigra italica.*)

The lombardy poplar is a native species of Italy. It is a tree that has been used in all civilized countries for landscape plantings. Its erect, columnar outline is a distinctive feature that gives it value for landscape uses. It is a

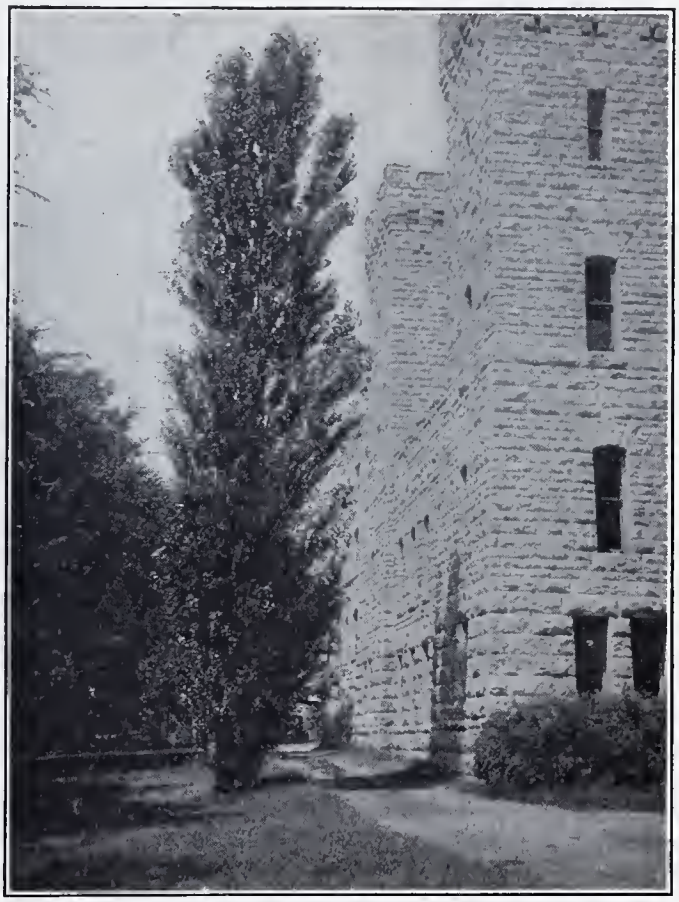


FIG. 51.—A lombardy poplar on the State Agricultural College campus, Manhattan. This tree is 40 feet in height and only 10 years of age, from date of setting. (*By Scott.*)

rapidly growing, short-lived tree of no economic value, but of great value for landscape uses.

This species is propagated entirely from cuttings. It requires a deep, rich, moist soil and should not be planted on dry, thin upland.

Persimmon.

(*Diospyros virginiana.*)

The persimmon grows abundantly throughout the southeastern fourth of the state. It is a small-sized tree seldom exceeding 25 feet in height or a foot in diameter. It grows most commonly on heavy clay land along the margins of timber belts and throughout pastures. It is usually found growing in clumps of a dozen or more trees rather than as single trees. The fruit of the persimmon is edible when fully ripe. The fruit clings to the tree for weeks after it ripens and furnishes an abundance of food for birds and animals during this time.

FIG. 52.—A group of persimmon trees. The foliage of the persimmon is very dark, heavy and dense. (*By Scott.*)

The wood is heavy, hard and strong. The sapwood is white while the heartwood is brown in the younger trees, turning black with advance in age. The heartwood is known as American mahogany and is used in many of the arts where a fine, close-grained wood is required.

The persimmon is a long-lived tree in favorable locations, frequently exceeding 100 years of age. It grows readily from seed. Staminate and pistillate flowers occur on different trees. In order to be sure of getting fruit it is necessary to grow several trees to insure fertilization. The persimmon is a very attractive tree when grown in the open where it has room to develop symmetrically. The tree provides dense shade and is worthy of a place in every back yard where a novelty tree is desired.

The Ashes.

(*Fraxinus.*)

There are four or possibly five species of the ash growing in this state. All are very similar in the character of their wood and economic value, but they vary in the matter of the size they attain and in their range of distribution.

White or American Ash (*Fraxinus americana*) is found only in the eastern third of the state, where it attains a height of 60 to 70 feet with diameters of 2 to 3 feet. It grows commonly along watercourses in deep, moist soil.

Fig. 53.—A white ash growing in a pasture near Eudora, Kan. This tree is about 45 feet in height and the stem is about 14 inches in diameter. (*By Scott.*)

Red Ash (*Fraxinus pennsylvanica*) is found growing throughout the length and breadth of the state. It is found most commonly along watercourses in deep, rich soil, but succeeds remarkably well even on dry prairie soil in the western part of the state, where it has been planted in groves and as street trees.

Green Ash (*Fraxinus lanceolata*) is found growing together with the red ash throughout the state and is in most characteristics very much like the red ash.

Blue Ash (*Fraxinus quadrangulata*) is a small-sized tree seldom exceeding 30 feet in height, and is found only in the southeastern fourth of the state. The slightly four-angled twigs of this species is one of the most distinguishing features.

The wood of the ashes is heavy, hard, coarse-grained and rather brittle, and very perishable in contact with the soil. The sapwood is white or tinged with

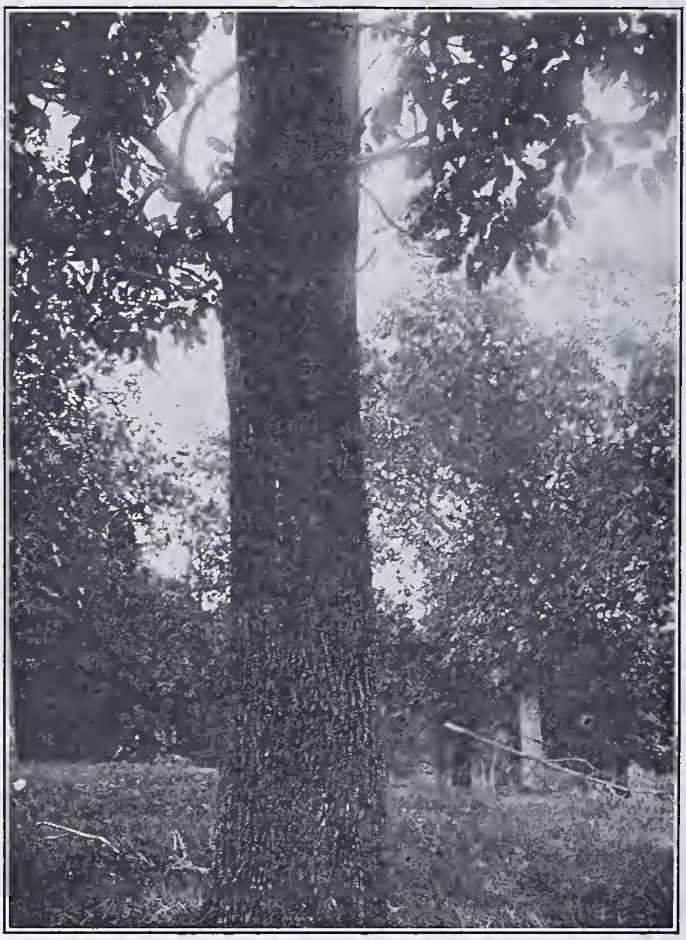


Fig. 54.—The stem of a white ash, showing the characteristics of the bark. This stem is nearly 2 feet in diameter. (*By Scott.*)

yellow in all the species, while the heartwood is brown. The wood of the ashes is used extensively for tool and implement handles, boat oars, ball bats and turned articles of all kinds, and in the structural parts of vehicles. It is also an excellent fuel wood. The ashes are a very valuable group from an economic standpoint. When grown in the open where they have room to develop symmetrically they are beautiful trees, fairly long-lived, wind-firm and comparatively free from seriously injurious insect attacks. They are readily propagated from seed and are easily transplanted from the nursery to their permanent location. On deep, rich soil they are a splendid tree for wood-lot planting. They are also

a valuable tree from the landscape standpoint. During the summer the foliage is bright green, turning golden yellow in autumn.

Catalpa.

There are two species of catalpa that are found growing in Kansas that have escaped from cultivation. They are *Catalpa speciosa* and *Catalpa catalpa*. The two species are very similar in general appearance but differ

FIG. 55.—*Catalpa speciosa* trees in winter, growing in dense stand, to be cut for posts. These trees are about 30 feet in height and their stems are about 8 inches in diameter.

materially in size and form of tree. The natural range of the catalpas is from southern Illinois and Indiana and southward through Alabama.

For a more extended discussion of *Catalpa speciosa* see the section in "The Wood Lot" of this volume devoted to this species.

Catalpa catalpa is an inferior species of no economic value and should never be planted.

Catalpa catalpa nana is an ornamental variety that has been planted very commonly throughout the state. It is a highly valuable decorative tree. The

striking characteristic of it is its full rounded head of very dense foliage. It is sometimes erroneously called the "umbrella tree." *Catalpa catalpa nana* is a dwarf variety that forms a very dense mass of foliage. Buds of this variety are inserted at any desired height in the stem of a *Catalpa speciosa.* The top of the *speciosa* is then cut out and the buds of *Catalpa catalpa nana* are allowed to form the top. This tree is a favorite nesting place for robins and mourning doves.

FIG. 56.—A service berry tree. This tree is growing in Doniphan county. It is approximately 30 feet in height and the stem is about 8 inches in diameter. (*By Bumgardner.*)

Shad Bush or Service Berry.

(*Amelanchier canadensis.*)

The service berry, as it is more commonly known, is a small-sized tree seldom exceeding 20 feet in height or 10 inches in diameter, and is found only in the southeastern section of the state. It is, however, a tree of wide distribution. Its range is from Newfoundland west to eastern Nebraska and Kansas, and southward to northern Florida. It grows in rich soils along the margin of woodlands. The small, purplish fruit that ripens in early summer is frequently gathered and used in making pies and jams. The berries in their season provide an abundance of food for birds.

The trees are propagated from seed. The foliage is very pleasing, and it is a tree that should be used in all park plantings, bird sanctuaries, or on grounds where a variety of trees is desired.

Crab Apple.

(*Malus ioensis.*)

The crab apple is a small-sized tree or large shrub in this state and its range is confined to the eastern third of Kansas. Its entire range is from Minnesota and Wisconsin southward to Louisiana and Texas. The bechtel crab is a double flowering form of this species and is planted very commonly as an ornamental shrub. It is of no economic value excepting that its occurrence as a species indicates the adaptation of the apple to our soil and climate and an added species to our arborescent flora. The fruit can scarcely be classed as edible except for birds and animals. Reproduction is from the seeds. It is seldom if ever grown in the nurseries. The blossom of the crab apple is white or soft pink, fragrant and quite showy when the trees are in full bloom. The bechtel double flowering crab is extremely showy. When in full bloom the trees are a mass of rose pink.

Fig. 57.—A thorn tree on the Kansas State Agricultural College campus, Manhattan. This is an exceptionally fine specimen.

Hawthorn or Thorntree.

(*Cratægus.*)

This genus embraces a score or more of varieties of small trees or shrubs found growing throughout the United States, Europe and Asia. Three or four varieties are found in the eastern portion of the state and several more can be found as specimen trees in city parks. When grown in the open with plenty of room to develop symmetrically they are a beautiful round-topped tree with dense foliage. The twigs are armed with stout, sharp thorns. When in blossom the trees are a mass of white. Honeybees frequent the blossoms and

birds regard the thorn trees as a safe nesting place. The thorn trees should be used more commonly in park and public grounds plantings. They are perfectly hardy and their presence adds much in the way of variety to any collection of trees. The fruits of the several varieties vary greatly in size, shape and general appearance. The fleshy outer covering is more or less highly colored in all the varieties and is quite showy during late summer and early autumn when fully ripe. It is not considered edible excepting for birds and animals.

An English garden is not complete if the thorn tree does not occupy a prominent location. Every bird sanctuary should have a number of thorn trees growing in it.

Plums and Cherries.

(*Prunus.*)

This genus includes the two groups, plums and cherries, both of which are represented by several varieties in this state.

THE PLUMS.

Wild Plum. *Prunus americana* is the common wild plum of the state. It is a small tree attaining a height of 18 to 24 feet. It prefers a rich, deep, moist but well-drained soil. Formerly it was a border shrub of the timber belt along the watercourses of the state. It is now commonly found in uncultivated corners and along fence rows. The fruit is edible and valued highly for making preserves and plum butter. The fruit of this species differs with the individual trees; generally it is from 1 to 1¼ inches in diameter, round or slightly elongated. When fully ripe it is yellow with pink cheeks. The trees or shrubs are irregular in their habit of growth. They usually grow in clumps formed by sprouts from the roots of the parent trees. When in blossom the trees are a mass of pure-white, highly fragrant flowers. The blossoms occur in early spring before the leaves come out.

The Sand Plum (*Prunus angustifolia*) is a small tree or shrub, seldom exceeding 10 feet in height, and is usually found growing in very sandy soils. The fruit is small, hardly exceeding a half inch in diameter. It is edible and is used in large quantities for culinary purposes. The sand plum usually grows in dense thickets covering the ground to the exclusion of all other vegetation on areas varying from a square rod to an acre or more. This species is common throughout the southwestern third of the state.

THE CHERRIES.

The Wild Black Cherry (*Prunus serotina*) is found growing throughout the eastern fourth of the state. Some of the largest specimens attain a height of 50 to 60 feet. Smaller and younger trees are more common. Usually they are found growing along fence rows or along the margin of timber belts.

The wild black cherry prefers a moist, rich, well-drained soil. It is a tree of wide distribution and is found growing from Nova Scotia to Florida and westward to eastern Dakota, Nebraska, Kansas and Oklahoma. On favorable soil it attains large sizes, often 4 or 5 feet in diameter. It is a valuable wood that is used in many ways. It is reddish brown in color, light in weight, strong, close fine-grained and takes a fine polish, and is used extensively for interior

finish. The bark yields hydrocyanic acid used in medicines as a tonic and sedative. The ripe fruit is used to flavor drinks and affords an abundance of food for birds.

The wild cherry is a very pleasing tree in general appearance. In the early spring masses of white blossoms make it very attractive and later its load of ripening fruit adds a touch of color that is very pleasing. It is a tree that

FIG. 58.—A sand-plum thicket in full fruitage. It is difficult to distinguish the fruit, which is concealed by the foliage. (*By Scott.*)

should have a place in every park and on every public grounds in the eastern third of the state.

THE CHOKE CHERRY (*Prunus virginiana* and variety *demissa*). This is a small tree or large shrub that grows throughout the length and breadth of the state. It is usually found growing in dense thickets along the border of timber belts. The blossom and fruit is somewhat similar to the blossom and fruit of the wild black cherry, excepting that the fruit is more astringent. The fruit ripens in midsummer and supplies an abundance of food for birds.

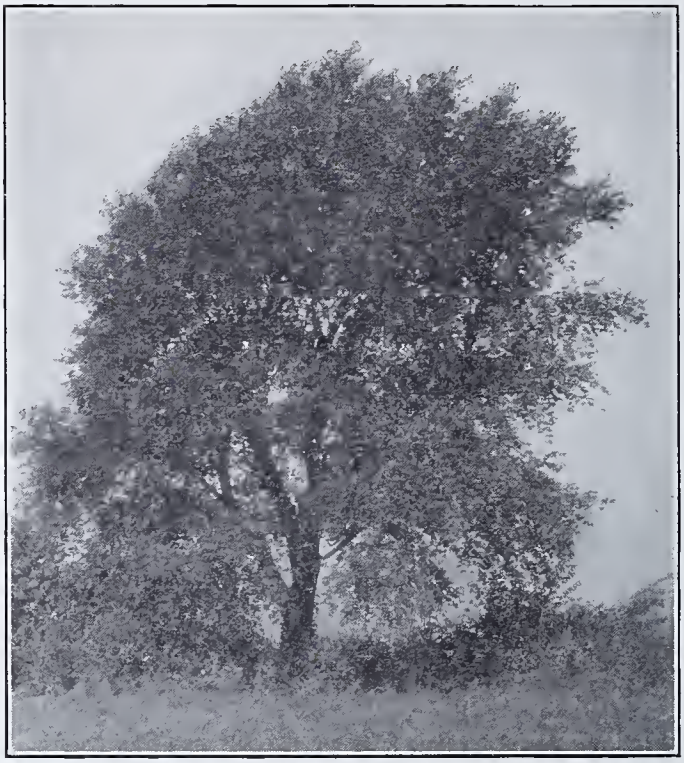


FIG. 59.—A black cherry tree in Atchison county. This tree, growing in the open, has developed a shorter stem and broader crown than it would have developed in a stand of timber. The cherry naturally develops a straight clear stem and a small crown. (*By Scott.*)

Redbud or Judus Tree.

(*Cercis canadensis.*)

The redbud is a small-sized tree that grows naturally throughout the eastern third of the state. It is usually found growing along the margin of timber belts. The tree is perfectly hardy and adapts itself readily to all types of soil. The wood is heavy, hard and very durable in contact with the soil. It is a valuable fuel wood. It is also a valuable ornamental tree. In the early spring the trees are a mass of rose-pink bloom with a pleasing fragrance. It is a hardy tree for the eastern two-thirds of the state and it should be planted generously in all parks and on all public grounds as well as in private grounds.

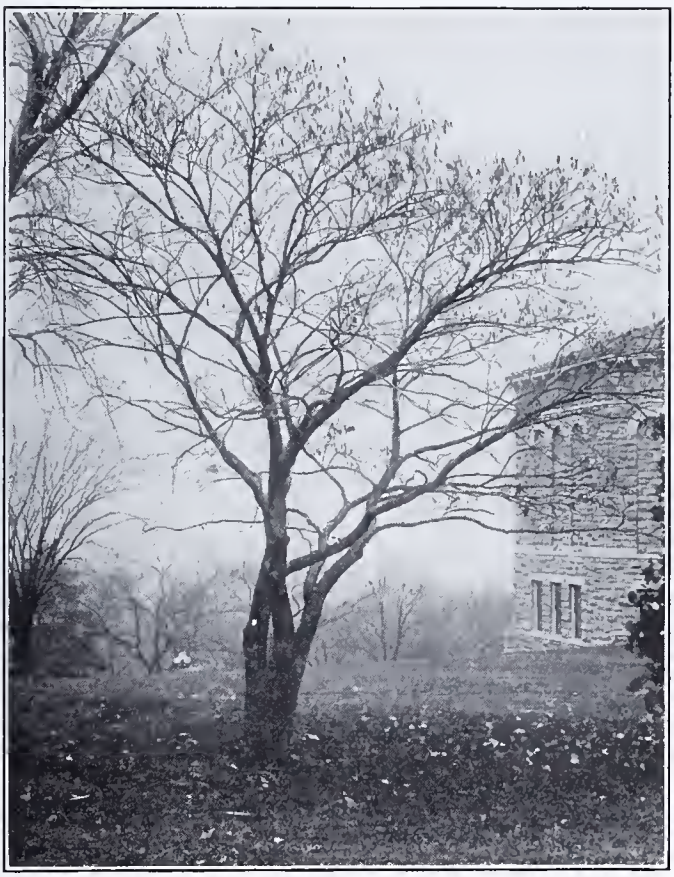


FIG. 60.—A redbud tree growing on the Kansas University campus, Lawrence, in winter. Note the seed pods clinging to the twigs. (*By Bumgardner.*)

Honey Locust.

(*Gleditsia triacanthos* and *variety inermis.*)

The honey locust is a common tree throughout the length and breadth of the state. It grows naturally in the eastern half and has been planted in timber-claim plantings throughout the western half. It is one of the hardiest of our broad-leaved trees and is well adapted to all kinds of soils. Usually this tree is free from insect attacks. However, following a series of droughty seasons they have been attacked and seriously injured by borers.

The wood of the honey locust is heavy, hard, coarse-grained, and quite durable in contact with the soil. Trunks of trees left lying on the ground to dry are usually attacked and almost devoured by the locust borer (one of the

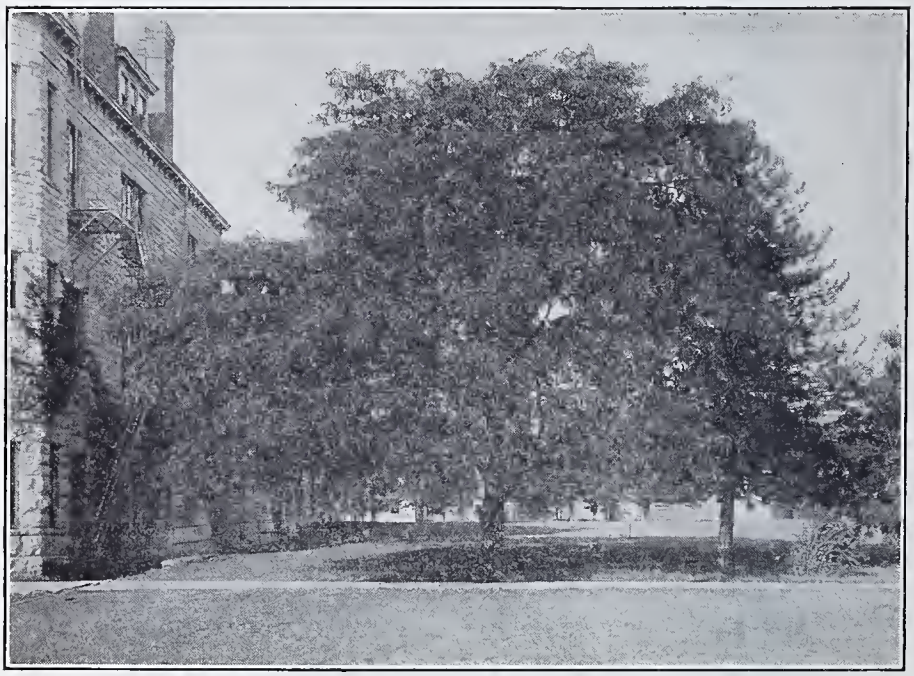


FIG. 61.—A honey locust tree on the State Agricultural College campus, Manhattan. A fine specimen of this species. (*By Scott.*)

flat-headed borers). The wood is of much value for fence posts and for fuel. The blossoms, though inconspicuous, are very fragrant and rich in honey. The trees are frequented by great numbers of bees when in blossom. The name honey locust was given this tree because of the honeylike fluid that the seed pods contain.

Because of the hardiness of this tree it should be used in all farm wood-lot plantings as well as in parks and on public grounds.

Coffee Tree.

(*Gymnocladus dioica.*)

The coffee tree is found growing in mixture with the other broad-leaved species throughout the eastern third of the state. The wood is heavy, hard, coarse-grained, and very durable in contact with the soil. It is a valuable

wood for fence posts and fuel. It is a tree that prefers a deep, moist soil, but adapts itself readily to drier soils. Normally it is a tree of medium rate of growth; on dry soils it grows more slowly. The striking characteristic of this species is its naked appearance during the winter season. The branches are heavy and thick with no twigs, and when destitute of foliage the tree has the appearance of having been pruned to a skeleton. The leaves possess a poisonous ingredient that is deadly to flies. The method used to poison them is to cut the leaves into a vessel and pour a small quantity of milk over them. In

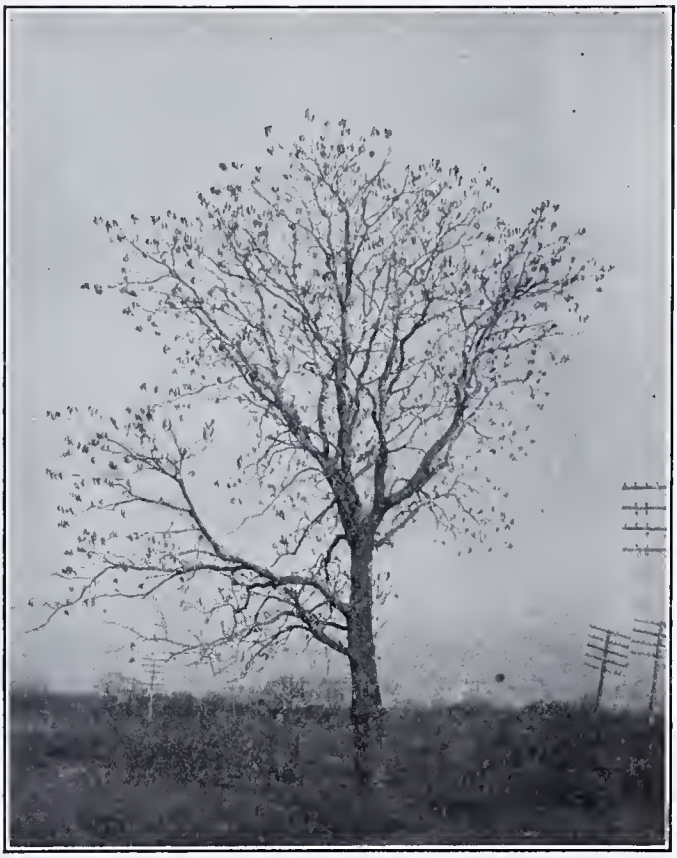


FIG. 62.—A coffee tree in winter. Note the numerous seed pods. These cling to the tree until early spring. The absence of small twigs is a striking characteristic of this species. (*By Scott.*)

a few moments the milk acquires a greenish color and flies that feed upon it never leave the receptacle.

The seeds of this tree are about a half inch in width, nearly black in color and the shell is as hard as bone. The trees are propagated entirely from seed. These should be soaked until the hard shells soften, or else scarified. This will require days or perhaps weeks of soaking, which will naturally shorten the time of germination. The same results may be accomplished by planting the seeds in the fall. The soil moisture and freezing weather soften the seed coat.

This is a suitable tree for wood-lot planting throughout the state, and it should also be planted in all parks and on all public grounds as specimen trees.

Pagoda Tree.

(*Sophora japonica.*)

The pagoda tree is an introduced species of comparatively recent date and at present will be found only in parks and on experimental grounds. It has proven entirely hardy in eastern Kansas. It resembles the black locust in many respects, but is entirely free of thorns. It blossoms late in the summer and the seeds hardly mature before frost. It is propagated entirely from seeds. It is a tree that should have a place in all parks and on grounds where a variety of species is desired.

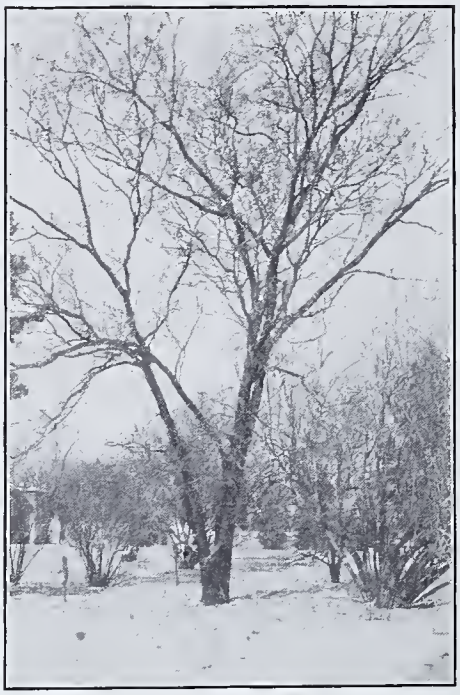


FIG. 63.—A pagoda tree in winter. This tree is about 40 feet in height and the stem is about 16 inches in diameter. Growing on the Kansas State Agricultural College campus, Manhattan. (*By Gates.*)

Yellow Wood.

(*Cladrastis lutea.*)

The yellow wood is an American tree of rather restricted range. Its region of distribution is throughout Kentucky, Tennessee and Alabama. It prefers limestone cliffs and ridges, but also demands rich soil. An occasional specimen tree of this species may be found in eastern Kansas, where it appears to be perfectly hardy. It is a comparatively small-sized tree at the best and is valuable only as an additional species in a collection of trees. It should have a place in all park and public grounds plantings.

Black or Yellow Locust.

(*Robinia pseudoacacia.*)

The black or yellow locust was originally an Appalachian mountain tree covering the slopes of the mountains from Pennsylvania to northern Georgia. It was brought westward with the march of civilization and is now a common tree throughout the states east of the Rocky Mountains. It perfers a rich moist soil, but adapts itself readily to dry barren soils. On favorable soils it is a tree of unusually rapid growth. The wood is heavy, hard and very durable in

FIG. 64.—A yellow wood tree on the Kansas State Agricultural College campus, Manhattan. This tree is fully 35 feet in height and the stem is about 18 inches in diameter. A fine, thrifty specimen of this species. (*By Bumgardner.*)

contact with the soil. It is a valuable post, pole and fuel wood. It was planted extensively throughout the state during the "timber-claim days." In most cases the young trees started off in a very promising manner, but were soon attacked by the black or yellow locust borer in such number that the trees were ruined in from one to three years' time. There is no practical method of combating an attack of the borer. Were it not for the borers the black or yellow locust would be the most valuable tree known at this time for wood-lot planting in Kansas. This species has been planted in the steppes of Russia,

where the borer is not known and the trees are making a wonderfully fine growth, and supplying valuable timber materials in a formerly treeless region.

The blossoms of the black or yellow locust are large clusters of white flowers that are very fragrant. The seeds are of hard, bony, beanlike structure with flinty shells. The tree is propagated entirely from seeds that must be soaked several days before they are planted to insure germination, or else they should be planted in the fall so that the soil moisture and freezing weather

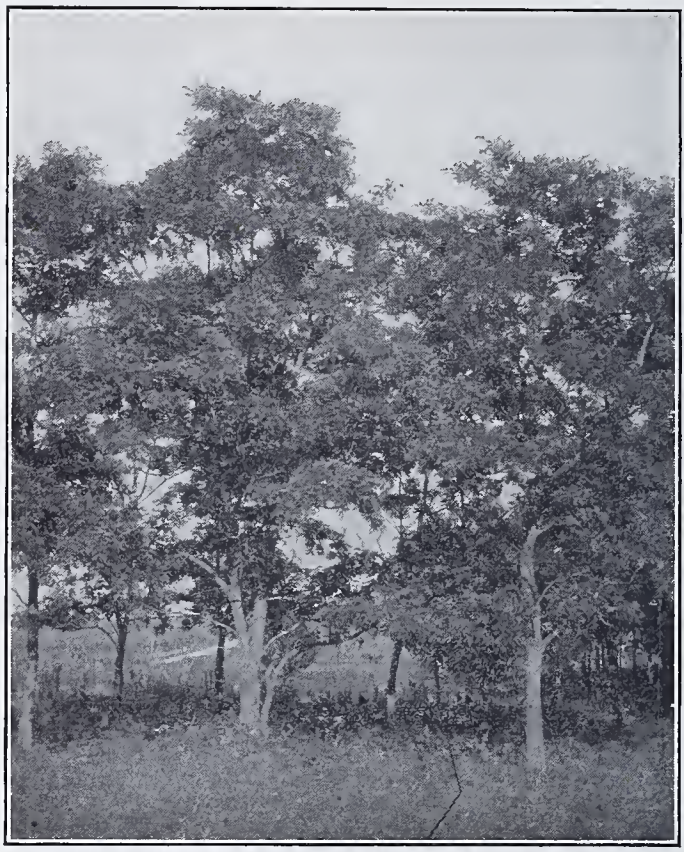


FIG. 65.—A group of black locusts. This is one of the hardiest of our broad-leaved species and adapts itself readily to most all types of soil. The black locust borer is its worst enemy. When not attacked the black locust makes a rapid growth and is a very useful wood. (*By Scott.*)

will have time to obtain the same results as soaking. One criticism regarding this tree is that it sprouts freely from the roots and invariably forms dense thickets of thorny brush that are almost impenetrable by man or beast.

Sweet Gum.

(*Liquidambar styraciflua.*)

The sweet gum is a tree of wide range extending from Connecticut to Florida and west to southeastern Missouri. It is found only as specimen trees in Kansas. It is a tree that grows naturally in rich bottom land that is frequently inundated, or along the borders of swamps. Being a moisture-

loving tree it is not well adapted to Knsas soil or climatic conditions, and therefore it cannot be recommended for general planting.

FIG. 66.—A sweet gum growing in Topeka. This is a beautiful specimen of this species. (*By Gates.*)

Sycamore.

(*Platanus occidentalis.*)

The sycamore in its natural range extends from the New England states west to eastern Nebraska and Kansas and southward to the Gulf Coast. It attains the largest size of any of our American hardwood trees. On favorable soils it attains a height of 150 feet or more, with trunks measuring 10 feet or more in diameter. It is a tree that requires an abundance of soil moisture to attain its best development. It is usually found growing along the edge of streams or on rich bottom land. However, it adapts itself readily to drier soils. Thrifty specimens of this species may be seen in the vicinities of Hays and Larned. One peculiar feature of this species is its habit of shedding its bark annually. The bark on the limbs and stems up to 12 or 15 inches in diameter loosens and peels off in large sheets during the winter and early spring months, leaving the surface beneath smooth and white. On shedding their bark the trees have the appearance of having been freshly painted.

The sycamore is propagated from both seeds and cuttings. The seeds are minute club-shaped affairs clustered around a hard woody center that make up the sycamore balls or buttons. The wood of the sycamore is reddish

brown and has very pronounced medulary rays. When quarter-sawed and polished the wood is one of the most beautiful of our American woods. It is coarse-grained, not strong and very perishable in contact with the soil. It is used to some extent for interior finishing and extensively for tobacco boxes, butchers' blocks and furniture. It is a tree that should have a place in all parks and public grounds. It is worthy of more consideration for western Kansas plantings than it has been given heretofore.

FIG. 67.—A sycamore in winter, showing the seed balls or buttons, as they are frequently called. Loose sheets of bark may also be seen along the stem. (*By Gates.*)

Russian Olive.

(*Elæagnus angustifolia.*)

The Russian olive is a native of Russia found growing under natural conditions in southern Europe and western Asia. It has been planted to a considerable extent in China.

In the United States the Russian olive has for a number of years been growing very successfully throughout western Minnesota, Iowa, North and South Dakota, Nebraska, Kansas, Oklahoma and the panhandle of Texas, withstanding the severest drought and the most extreme cold that have been experienced during this time. This is sufficient proof that it is well adapted to our climatic conditions, and inasmuch as it is adapted to growing in a wide

range of soils it is a tree that deserves more consideration for general planting purposes throughout western Kansas than it has received in past years.

The tree when properly handled makes hedges that are almost impervious to man or beast. As a windbreak it is unexcelled. Growing as it does in the driest deserts, it is used extensively in those regions to protect the cultivated crops of the oases against the desert winds. It has been noticed that crops growing close up to a row of Russian olive trees are not impoverished to any extent. For this reason the natives of central Asia prefer this tree to any other sort for windbreak planting. The trees are well adapted for growing in pure sand and even in alkali soils. They exist with very little water, although under such conditions they do not make a luxurious growth.

As a sandbinder the tree is of great value in checking the encroaching desert

FIG. 68.—A Russian olive growing in Trego county, Kansas. This tree is 30 feet in height. Its spread of limbs exceeds its height. (*By Scott.*)

sands. It is also used along irrigation ditches, where its great masses of fibrous roots prevent the soil to a great extent from washing.

Its wood constitutes the chief supply of fuel in many of the oases. To furnish this wood the trees are pollarded every four or five years. Pollarding is the practicing of cutting the tops out of the live trees at heights varying from 6 to 12 feet from the ground so that a new top can be developed. As the Russian olive responds readily to such treatment, the practice is general wherever the trees are grown.

The wood, when thoroughly dried, possesses fine heating qualities. A bed of lives coals when covered with ashes will last throughout the night.

The fruit of this olive is not edible. However, the dry cast-off leaves are a favorite food of sheep, goats, cattle and donkeys. The flowers, though inconspicuous, are very fragrant and rich in honey. These qualities, combined with its ability to withstand drought and alkali soils, put it in the first order as a desirable tree for the more arid parts of the United States.

The Russian olive is a medium-sized tree seldom exceeding 50 feet in height under the most favorable conditions. On high, dry prairie land its rate of growth is much slower than on moist soils. But it is a persistent grower and if given a chance it will make a satisfactory growth under the most adverse conditions. Under favorable conditions its rate of growth compares favorably with the soft maple. The leaves are silvery white, and on this account it makes a pleasing variation when planted in mixture with other trees.

The tree is highly recommended for yard and park planting in mixture with other species throughout the entire western part of Kansas. It reaches sufficient size and is altogether suitable for street planting. For hedges the trees should be planted 18 inches apart in single rows, and they should be kept

FIG. 69.—Russian olives growing in the State Park, Hays, Kan. These trees were photographed eight years after planting, and they were from 16 to 18 feet in height. They have made a thrifty growth and many of them are as much as 30 feet in height. (*By Scott.*)

trimmed to a uniform height of 3½ to 4 feet. For windbreaks they should be planted from 3 to 6 feet apart in rows 7 or 8 feet apart, and should be permitted to grow without being cut back. The trees naturally head low and grow rather sprangly. When planted for street or yard trees, the lower limbs should be removed early in their development so that the tree will develop a desirable form.

Little is known in regard to the durability of the wood in contact with the soil. However, it is safe to conclude that the wood must be durable to withstand the treatment to which the trees are subjected in China when pollarded for fuel purposes.

The Russian olive is propagated either from seed or by cuttings. The trees come into bearing when from six to eight years old, and yield large quantities of seeds that ripen in autumn. When ripe, they are gathered and stored dry or stratified until the following spring. When stored dry they should be

soaked in water of moderate temperature for a day or two before they are planted. If planted without being soaked the seeds sprout very irregularly. Some of them come up within two or three weeks after they are planted, others lie in the ground for a month or two before they come up, and many remain dormant until the following season.

Soapberry or Wild China Tree.

(*Sapindus drummondi.*)

The soapberry is a small-sized tree at the best. In Kansas it seldom exceeds 20 feet in height. It is very pleasing in appearance. The leaves resemble a hickory, excepting that they are much smaller. The seed is a nutlet with a fleshy covering that is not edible. These ripen in the fall and hang on the trees until late winter or early spring. This is a southern species, its range of natural distribution extending through Louisiana, Arkansas, southern Kansas, Oklahoma and Texas into Mexico. It prefers a moist clay soil, but is often found on dry limestone uplands. In the most favorable locations it attains a height of 40 or 50 feet and diameters up to 2 feet. The wood is heavy, strong, close-grained, light brown tinged with yellow. It is used largely in the manufacture of baskets and the frames of packsaddles. It is a tree of no economic value in Kansas excepting for park planting and the value of an additional species in the list of native trees.

The Ohio or Fetid Buckeye.

(*Æsculus glabra.*)

The Ohio buckeye is a small-sized tree in Kansas. It is found growing only in the eastern third of the state. It demands a rich, moist soil and is found only in a mixture with larger hardwood species along watercourses. It prefers partial shade to direct sunlight. Its entire range of distribution is from Pennsylvania to Alabama and westward to eastern Nebraska, Kansas and Oklahoma. In favorable locations it attains a height of 60 to 70 feet with diameters up to 2 feet. The wood is light, soft, close-grained, not strong, and nearly white. It is used extensively in the manufacture of artificial limbs and numerous articles of turned nature.

It is one of the very earliest of trees or shrubs to come into leaf in the spring. For this reason it is a desirable tree for park and public grounds plantings.

The sprouts and new growth of the Ohio buckeye possess a poisonous ingredient that is deadly to cattle. There is always danger of loss from this cause if cattle are allowed to graze in the woods in the early springtime where this species is common.

The seeds of this species are nuts that are about three-fourths of an inch in diameter, the shell of which is a rich brown and capable of taking a high polish. A common superstition is that a buckeye carried in one's pocket will bring the possessor good luck. Another is that a buckeye carried in one's pocket is a sure cure for rheumatism.

FIG. 70.—Ohio buckeye. This specimen is about 12 feet in height and is very typical of the buckeye as it grows in Kansas. (*By Scott.*)

The Maples.

THE SUGAR MAPLE (*Acer nigrum*) is the most valuable of the maples. Its range within the state is confined to a narrow belt along the east end of the state. It prefers deep, rich, moist soils, and is usually found growing along watercourses and extending up over steep hillsides on the north and east exposures. It is one of the most tolerant of our broad-leaved species, growing as seedlings in dense stands under other hardwood trees. In this state the sugar maple attains a height of 60 feet or more and a diameter of 3 feet or over. It is a tree that does not endure extreme heat or droughty conditions and can be grown only where the soil and atmospheric conditions are favorable.

The sugar maple is a tree of wide distribution throughout its natural range, extending from the St. Lawrence river south to Virginia and Kentucky, and westward to southeastern Dakota, eastern Nebraska and eastern Kansas.

The sugar maple is a beautiful tree at all seasons. During the summer months the foliage is extremely dense, providing dense shade. In the fall it is rich in autumn colors. It is a tree that should be used in all park and public grounds within its range of successful growth. It is a tree of rather slow growth and should be planted in mixture with other trees that will protect it until it becomes thoroughly established.

THE SILVER MAPLE (*Acer saccharinum*) is found growing naturally throughout the eastern third of the state and has been planted very generally throughout the eastern half of the state. It is a tree that grows readily and rapidly, making a splendid showing in a very few years. The tree is very pleasing in appearance. The leaves are silvery gray on the under surface; hence the name "silver maple." It attains a height of 50 to 60 feet on favorable locations with

diameters often up to 3 or 4 feet. It can be classed as a short-lived tree, seldom living to exceed 50 years of age.

The wood of the silver maple is straight-grained, splits readily, very perishable in contact with the soil. It is used extensively in the manufacture of furniture.

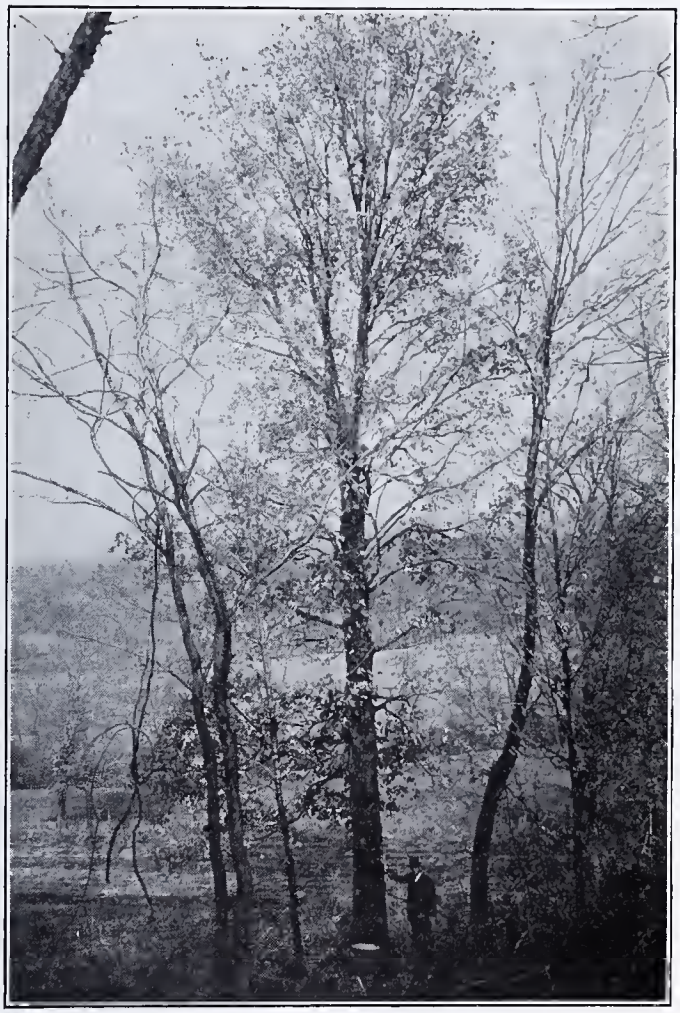


FIG. 71.—A splendid specimen of sugar maple as they grow in Linn county, Kansas. Note the bucket at the foot of the tree in which sap is being collected, to be boiled down to syrup or sugar. (*By Scott.*)

It is a tree that requires a deep, rich, moist soil in which to make its best growth. On high, dry soils it makes a very unsatisfactory growth. Because of the straight-grained character of the wood, the trees are frequently split by windstorms. Fungi find this tree to be a favorable host, and many of the older trees show injury from this source.

The silver maple is a tree that should be planted only for immediate results and in mixture with longer-lived species that will ultimately occupy the ground.

THE BOXELDER, OR ASH-LEAVED MAPLE (*Acer negundo*) is a native tree in the eastern half of Kansas and it was planted throughout the state during the life of the "timber-claim act." It is a tree that requires a deep, rich, moist soil to attain its best development. In such soils it frequently attains a height of 50 feet with a diameter of 3 to 4 feet. On drier soils it is little more

FIG. 72.—A silver maple as they appear in winter. This tree is fully 60 feet in height with a spread of limbs equal to its height.

FIG. 73.—A roadside planting of hard maples. When grown in the open the hard maple develops a very symmetrical, full, dense crown and retains its branches from the ground up. It is a splendid shade tree. (*By Scott.*)

than a small tree or shrub. It is a short-lived tree at the best. The wood is of no value except for fuel. There is no excuse for planting this tree, excepting that it counts as another species in a collection of trees. It will grow only where other more valuable species will grow equally as well.

The maples are all propagated from seeds. The seeds of the silver maple ripen in May and must be sown immediately or they will perish. The seeds of the sugar maple and boxelder ripen in the fall. They may be sown as soon as ripe or they can be held over until the following spring if stratified or kept in a basement room where they will not suffer from extreme dry conditions.

FIG. 74.—A black walnut growing in an open field. This form is very characteristic of the black walnut in open situations. When grown in thick stands the tree develops a tall, clear stem and a small crown. This tree is about 30 years of age. It is about 30 feet in height with a stem diameter of 18 inches. (*By Scott.*)

The Black or American Walnut.

(*Juglans nigra.*)

The black walnut is one of the most valuable of our Kansas trees. It is found growing commonly throughout the eastern half of the state on deep, rich, well-drained land along creek and river valleys.

During the "timber claim days" black walnuts were planted extensively in the plains section. With but few exceptions they proved to be a short-lived tree on the high, dry situations. When planted in ravines in deeper soil and where the young trees were benefited by the flood waters they reached sufficient size and age to be of value for farm-timber supplies.

From a commercial standpoint the black walnut is the most valuable tree

that grows in Kansas. Nowhere within its natural range of growth does it attain a greater degree of perfection than in this state.

The wood of the black or American walnut, so called to distinguish it from the Circassian walnut, possesses a rare combination of highly prized qualities, and it is sought above all other woods for certain particular uses. Its relative freedom from warping, checking, or splitting under alternate wet and dry conditions, and its resistance to decay and insect attack permits the wood to be used under all conditions. It works easily under tools. The wood is hard, heavy, straight-grained, stiff and strong. It takes a high polish, and because

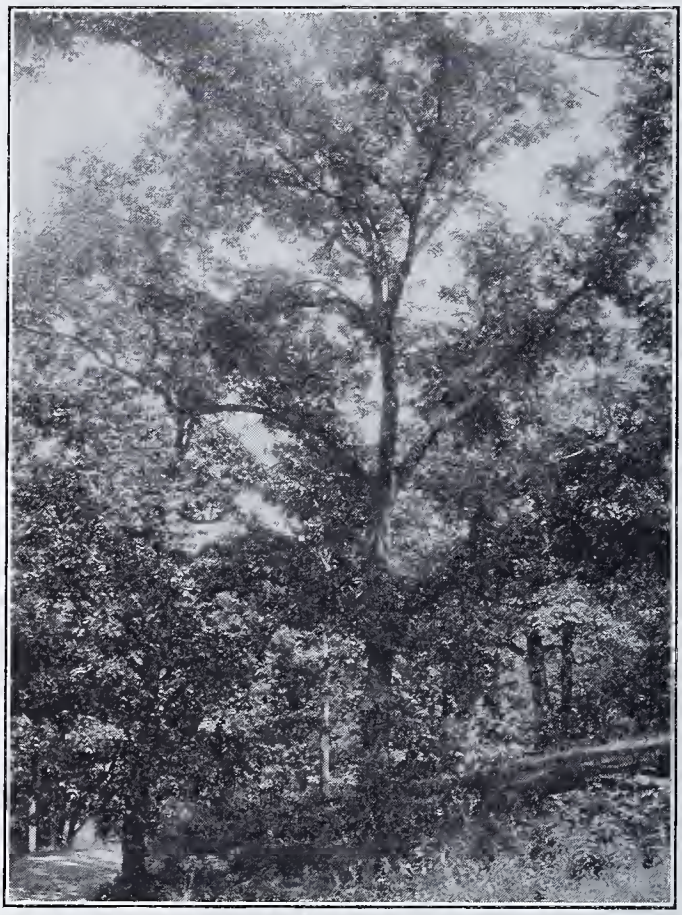


FIG. 75.—Black walnut growing in mixture with other trees. When grown under such conditions they develop straight stems with few branches. (*By Scott.*)

of its dark color it seldom shows stain marks. It is a wood that is especially prized for automobile steering wheels and gun stocks. It is used extensively in the manufacture of furniture, organs, pianos, sewing machines, tables, caskets, cabinet work, picture frames, mouldings, stair rails, and many forms of ornamentation. It was formerly used as solid lumber, but in recent years, on account of its growing scarcity and the consequently high price that it commands, it has been used almost entirely as veneer.

The large stumps and logs from trees grown in the open, rather than from

forest-grown trees, yield wood of the highest quality. It is these trees that yield the curly figured grain so highly prized for exposed surfaces.

The black walnut is a stately tree, symmetrical in form, pleasing in appearance and highly desirable for park and roadside planting. The sap from the leaves and the hull of the fruit is rich in pigment that makes a permanent dark stain. For this reason the trees should not be planted along streets or in yards where children play, or near clotheslines.

The nuts of the black walnut are eagerly sought and are used as an article of food. The trees are propagated entirely from the nuts which should be planted in the fall in the location where the trees are to grow. The young trees develop a very strong tap root and are difficult to transplant with any degree of success.

FIG. 76.—A group of shellbark hickories growing under natural conditions in mixture with other trees. Note the tall, straight stems with practically no heavy branches. (*By Scott.*)

The Hickories.

THE PECAN (*Hicoria pecan*). A full discussion of this species is given under the general subject, "The Wood Lot."

THE BITTERNUT (*Hicoria cordiformis*). This is a tree of wide distribution. It is found growing generally throughout the hardwood region from Maine west to Minnesota and eastern Nebraska, Kansas and Oklahoma and southward to Florida. In the New England states it is one of the largest and com-

monest of the hickories, often attaining a height of 100 feet with trunks as much as 3 feet in diameter. In Kansas this species is found more commonly than any other of the hickories, but seldom exceeds 50 feet in height or 15 inches in diameter. It is usually found growing on hillsides or gravelly ridges bordering streams.

THE SHELLBARK OR SHAGBARK HICKORY (*Hicoria ovata*). This species derives its name from the peculiar manner in which the bark of this tree loosens and

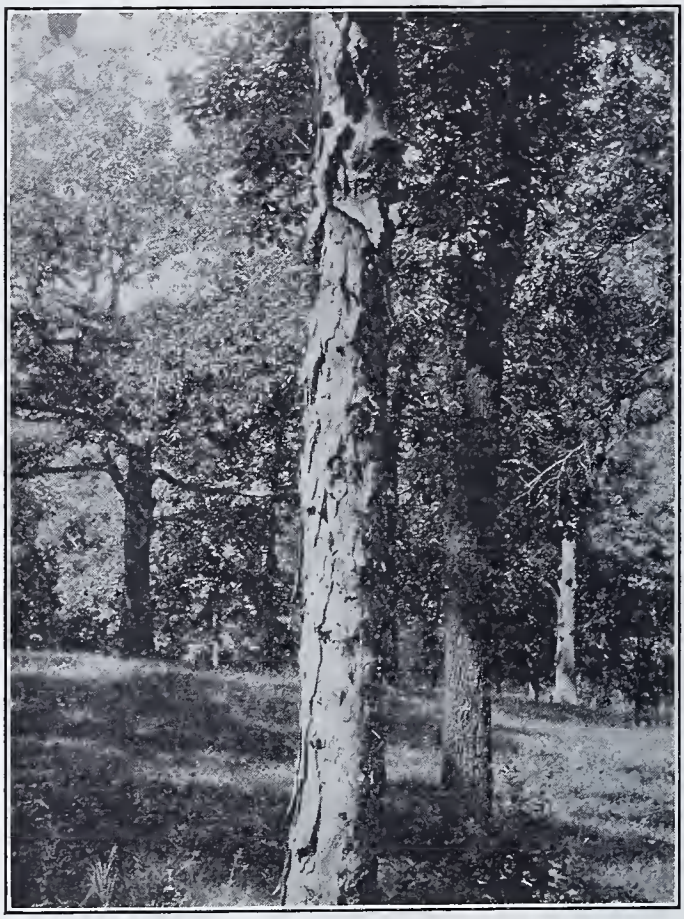


FIG. 77.—A stem of a shellbark hickory showing the characteristic bark, that loosens in large sheets and shells or peels off from time to time. (*By Scott.*)

shells off in large strips. This is also a tree of wide distribution. It is found throughout practically the entire hardwood region of the United States, very commonly in the Ohio river basin. In Kansas this tree is found in the eastern part of the state, growing in mixture with other hardwood species along the watercourses. It prefers deep, rich, moist soil and the protection of the associated trees from full exposure to the sun and wind.

THE BIG SHELLBARK HICKORY OR BOTTOM SHELLBARK (*Hicoria laciniosa*). This is one of the largest of the hickories and a tree of wide distribution. Its center of distribution is in Illinois, Indiana and Tennessee. It extends west-

ward to eastern Nebraska, Kansas and Oklahoma. Its growth is confined almost entirely to deep, rich bottom lands that are usually inundated for several weeks annually. In Kansas its range is confined to the lowlands along the Verdigris and Neosho rivers and their tributaries.

The Mockernut or Big Bud Hickory (*Hicoria alba*). This is one of the southern hickories, its center of distribution being in the lower Ohio river basin and throughout Missouri and southward. In Kansas it is found only in

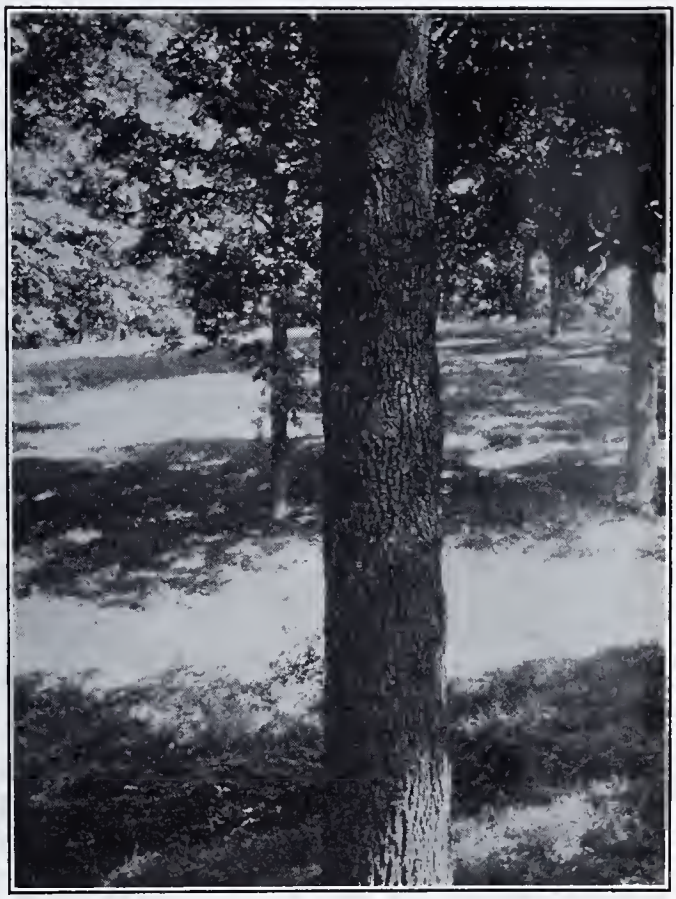


Fig. 78.—The bark of a bitternut hickory. The bark of this species divides into very narrow ridges that never loosen or scale off as the shagbark does. (*By Scott.*)

the southeastern section of the state. In this state it attains a height of 60 to 70 feet with trunks 2 feet or more in diameter. It is found growing with associated species of hardwoods on well-drained, rich, moist soil.

The Pignut Hickory (*Hicoria glabra*). This is another tree of wide distribution, extending from Maine westward to eastern Nebraska, Kansas, Oklahoma and southwestward into Texas and south into Florida. It is most common in Missouri and Arkansas. Its distribution in Kansas is throughout the eastern third of the state. It is not as common as the bitternut hickory, but it is found in practically every locality within the given range. It is found

growing on gravelly hillsides and ridges in mixture with other trees. In Kansas it seldom exceeds 40 feet in height or 18 inches in diameter. In Chautauqua county it occurs in the sandy ridges in mixture with the black-jack oaks.

The woods of the hickories are very similar and all are used for like purposes. They are heavy, hard, very strong, tough and flexible. The sapwood is white while the heartwood is light or dark brown. The wood is used exten-

FIG. 79.—A bitternut hickory growing in mixture with other trees. (*By Scott.*)

sively in the manufacture of agricultural implements, carriages, wagons, axe and tool handles, baskets, fuel, barrel hoops, and for curing smoked meats.

The hickories are not well adapted for general use in landscape or wood-lot plantings, excepting the pecan. They should, however, be planted in all parks where ground can be found that is suited to their needs.

They are propagated entirely from the nuts. These should be planted in the fall where the trees are to grow. They are a tap-rooted tree and transplant with much difficulty.

Hop Hornbeam or Ironwood.

(*Ostyra virginiana.*)

The hop hornbeam or ironwood is a small-sized tree of wide range. It extends from the St. Lawrence river westward to the Black Hills of South Dakota and southward through eastern Nebraska and Kansas, Oklahoma and Texas and extending to Florida. Occasionally it attains a height of 50 feet, but more commonly not exceeding 30 feet in height or 15 to 18 inches in diameter. It is always found growing in the shade of larger trees. It prefers dry, gravelly slopes and ridges to deep, moist soil. The wood is strong, hard, tough and durable. It is used for fence posts, tool handles, mallets and like articles.

This tree is a common understory species throughout the eastern third of Kansas on favorable sites. It is a tree that should be used only as a specimen tree in any planting. It is propagated entirely from seed, which should be planted in the fall.

FIG. 80.—A red or river birch growing in a park in Topeka. (*By Gates.*)

The Red or River Birch.

(*Betula nigra.*)

The red birch is a tree of wide distribution. Its range extends from Massachusetts westward to eastern Nebraska, eastern Kansas, Oklahoma and Texas and southward to Florida, where it attains its largest size. It is a tree that frequently reaches 80 to 90 feet in height and as much as 5 feet in diameter. It is the only one of the birches that ripens its seed in the spring or early summer. It is a moisture-loving tree and is usually found growing along the margin of streams or in marshy situations.

The wood of the red birch is light, hard, strong, close-grained and is used in the manufacture of furniture, woodenware and turned articles.

The red birch is often planted as an ornamental tree in the northeastern states. It should have a place in all parks in eastern Kansas where suitable soil conditions exist. Its natural distribution in the state is confined to the southeastern section, where it is found growing along the watercourses and attaining a height of 50 feet or more.

It is propagated entirely from seed, which should be sown as soon as it ripens. Partial shade must be provided to protect the tender seedlings from the sun and wind.

The Oaks.

(*Quercus.*)

The oaks are divided into two distinct groups, the black-oak and white-oak groups. The members of the black-oak group are readily recognized by the bristle-tipped points of their leaves and the fact that it requires two seasons to mature the acorns. The members of the white-oak group have blunt or rounded leaf points, and they mature their acorns in a single season.

The wood of the black oak is heavy, hard, strong, coarse-grained, reddish brown in color, perishable in contact with the soil. It is used extensively for interior finishing, flooring and furniture.

The wood of the white oak is heavy, hard, strong, close-grained, light brown in color, durable in contact with the soil and in exposed situations. It is used extensively in shipbuilding, for construction timbers of all sorts, cabinet-making, cooperage, in the manufacture of carriages and agricultural implements, baskets, railway ties, fencing and fuel. All in all the white oak is one of the most useful and serviceable of our American woods.

The oaks are all propagated from seed. The acorns should be gathered as soon as they fall to the ground, stored until spring in a cool, moist room where they will not shrivel or dry out, or else they should be planted at once. In wood-lot plantings the acorns should be planted where the trees are to grow. For other uses they should be planted in the nursery, and be grown to desirable sizes for the respective plantings.

THE BLACK OAKS.

THE RED OAK (*Quercus maxima*). This is a tree of wide distribution, extending from Quebec to northern Georgia and westward to eastern Nebraska and Kansas. In favorable soil it attains a height of 100 feet or more with diameters up to as much as 4 feet. It prefers a moist clay or gravelly soil. On suitable locations it makes a rapid growth and clears itself of limbs readily to a height of 30 feet of more. In Kansas it is found growing very commonly throughout the eastern third of the state, usually on slopes and ridges bordering streams. It is one of our most beautiful broad-leaved trees. The foliage throughout the summer is deep green with a shiny surface, and in the fall it takes on the deepest of autumn colors.

The red oak is often planted for street, yard and park trees and is very satisfactory as such. It is a tree that should be used more commonly in all plantings.

THE PIN OAK (*Quercus palustris*). This tree is found extending westward from Massachusetts to eastern Kansas and Oklahoma and southward through

Tennessee. It is strictly a bottom-land tree and is frequently found growing on the borders of swamps and on land that is frequently inundated. It is a tree of fairly rapid rate of growth and usually grows in dense stands. The pin oak frequently attains a height of from 90 to 120 feet, with trunk diameters of 3 to 5 feet. One of the striking features of the pin oak is the large numbers of small branches that persist and extend at nearly right angles to the stem supporting them. It is seldom that the trees clear themselves to any considerable extent.

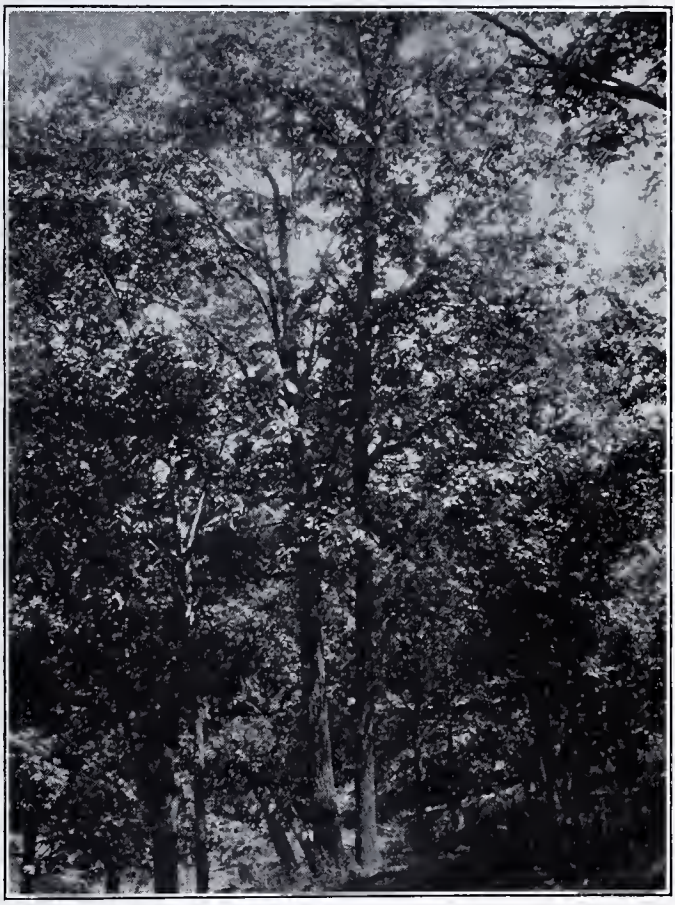


FIG. 81.—A pair of red oak trees in natural timber. Note the straightness of the stems and their freedom from limbs for a considerable height. These are characteristics of red oak when grown in forest conditions. (*By Scott.*)

During its youth the pin oak is one of the most shapely and symmetrical of our broad-leaved trees. It is handsome and pleasing from every standpoint. The pin oak transplants quite readily and it has been planted extensively as an ornamental and shade tree throughout the Eastern states as well as in European countries. Inasmuch as it is a swamp-type tree it should be planted only in moist, deep soils.

The pin oak is a common tree along the watercourses in the southeastern section of Kansas.

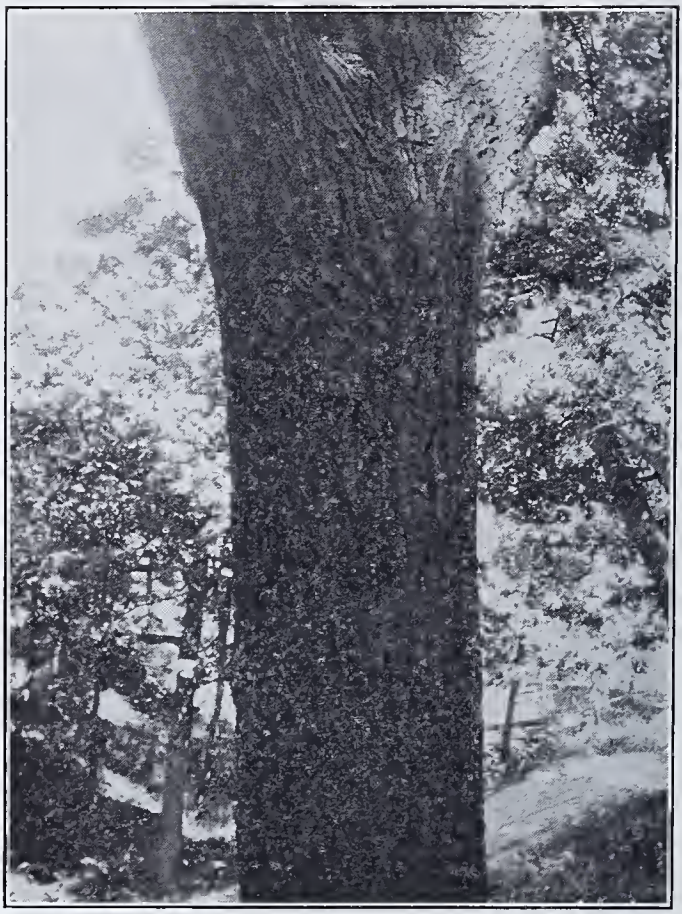


FIG. 82.—Bark characteristics of the red oak. On large stems the bark is deeply furrowed, but does not loosen or flake off. (*By Scott.*)

FIG. 83.—A group of pin oaks on the Kansas State Agricultural College campus. Note the straight stems that are very characteristic of this species. The lower branches on these trees have been removed to enhance their appearance.
(By Scott.)

FIG. 84.—A pin oak on the Kansas State Agricultural College campus. The pin oak when grown in the open is symmetrical in outline and retains its limbs from the ground up. In appearance it is one of our most beautiful broad-leaved trees. (*By Scott.*)

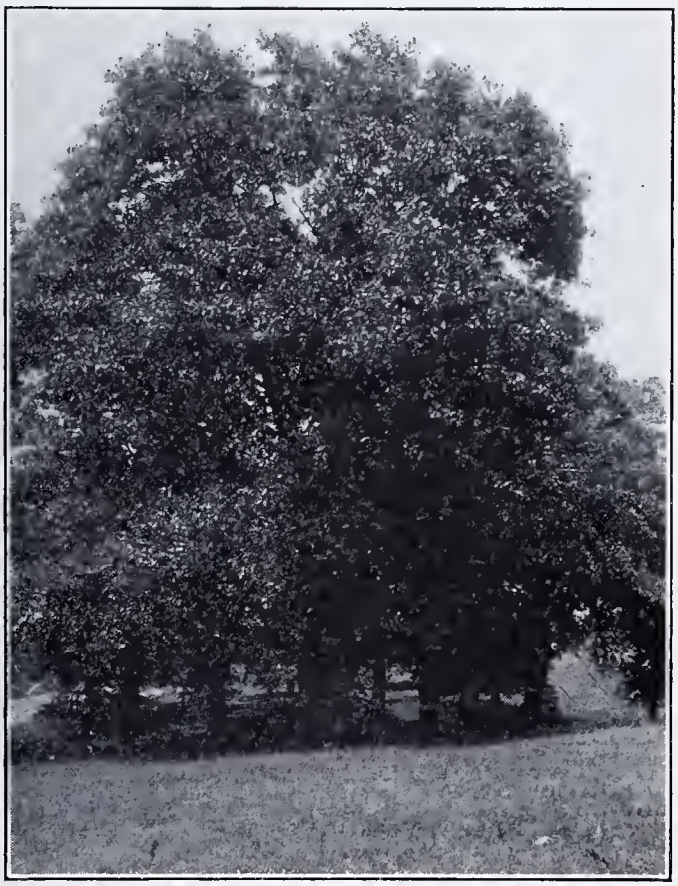


FIG. 85.—A group of black oaks in a pasture in Jefferson county. When grown in the open the black oak develops a short stem and a full rounded crown very pleasing in appearance. (*By Scott.*)

THE BLACK OAK (*Quercus velutina*). This is one of the common species found growing on dry gravelly ridges and uplands from Maine south and west as far as eastern Nebraska, Kansas, Oklahoma and Texas and southward to the Gulf coast and into northern Florida. It is a tree that attains a height of from 80 to 150 feet with diameters varying from 3 to 4 feet. It is abundant throughout the Mississippi basin, attaining its largest size in the lower Ohio river country.

The black oak is a common tree throughout the eastern third of Kansas, often making up fully half or more of the trees on the slopes and ridges over-

FIG. 86.—A black oak. Photographed December 1. Trees of this species hold their leaves until midwinter or even later. This tree is about 45 feet in height and its stem is about 3 feet in diameter. It is probably 100 years of age. (*By Scott.*)

looking the watercourses. As a tree it is very pleasing in appearance. The foliage throughout the summer is deep green. In the fall it is rich in autumn colors. It is seldom if ever used for street or shade trees, the red and pin oaks being preferred.

THE BLACKJACK (*Quercus marilandica*). This species is found growing on dry sandy or barren clay soils from New York westward through Ohio and Indiana to eastern Nebraska, Kansas and Oklahoma, and southward in Texas. It reaches its largest size in Arkansas and eastern Texas. At its best it is a small-sized tree, seldom reaching 50 feet in height and more commonly from 20 to 30 feet in height.

The blackjack is a common species on dry sandy ridges throughout the eastern third of Kansas, where it forms dense thickets. It is never used for

street or yard plantings. It is a tree of very slow growth and of no economic value excepting for fuel.

THE SHINGLE OAK (*Quercus imbricaria*). This is a tree of wide distribution, but it never occurs in large numbers. Its range is throughout the hardwood region of the Central states. In Kansas it is found occasionally only in the northeastern section of the state. It is a tree of very dense foliage, which is

FIG. 87.—A shingle oak on the Kansas State Agricultural College campus. This tree is approximately 40 feet in height and a fine specimen. (*By Scott.*)

retained until midwinter. The branches of the shingle oak are slightly drooping. It is used in a limited way in park plantings. It is a tree that requires deep, rich soil, either upland or bottom.

THE WHITE OAKS.

THE WHITE OAK (*Quercus alba*). This is a tree of wide distribution throughout the hardwood region of the Central states. It is one of the most valuable of the oaks. It frequently reaches a height of 80 to 100 feet, with trunks measuring 3 to 4 feet in diameter. It is a tree that is not particular regarding its

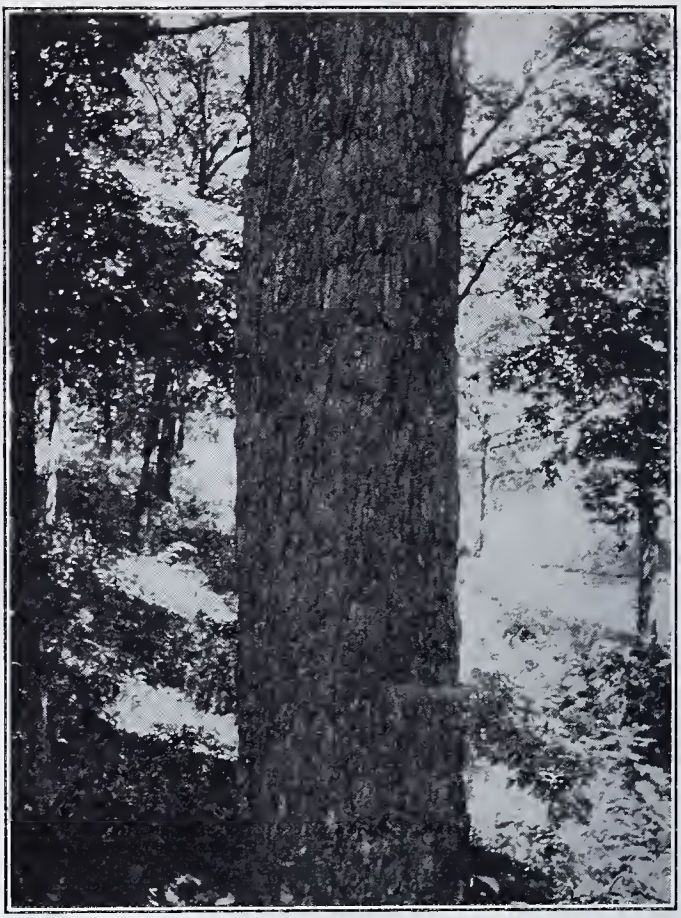


Fig. 88.—Bark characteristics of the white oak. On stems of considerable size the bark loosens in narrow but flat sheets and flakes off. (*By Scott.*)

Fig. 89.—A white oak about 40 years of age. This tree is about 35 feet in height and has a stem diameter of 16 inches. This is a very characteristic form of a young white oak grown in an open location. (*By Scott.*)

soil requirements, growing equally well on sandy plains, gravelly ridges, rich uplands or moist bottom lands. It frequently forms nearly pure forests. It is the most abundant and attains its greatest size on the western slopes of the southern Alleghany mountains.

In Kansas this species is found only in the northeastern section of the state,

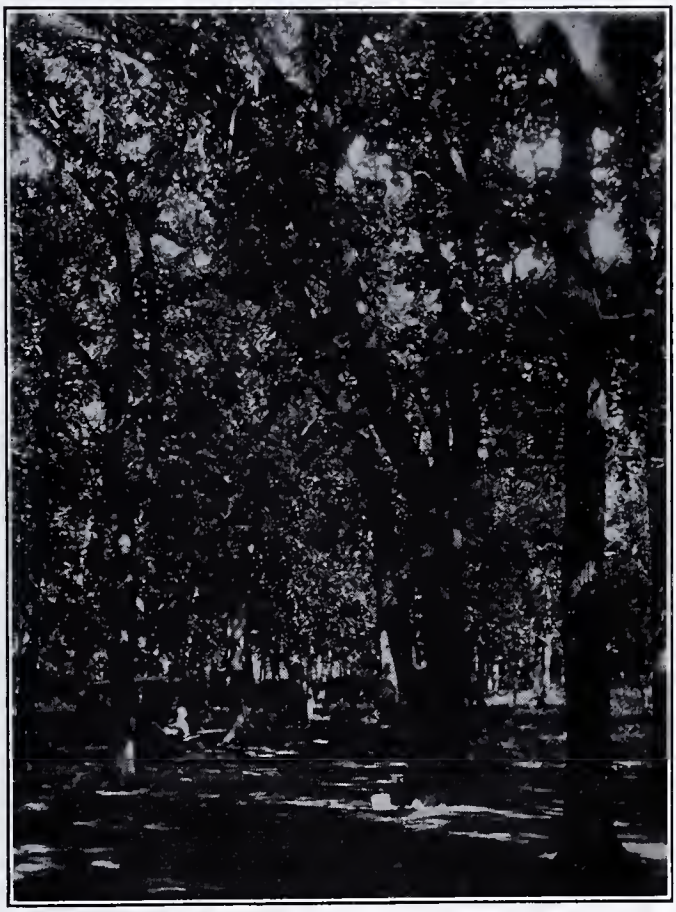


FIG. 90.—A group of bur oaks in mixture with other trees growing along a creek in Riley county, Kansas. The oaks are shown in the foreground. The stems of these trees range from 2½ to 3 feet in diameter and they have plenty of clear length to make good saw logs. (*By Scott.*)

growing in mixture with the other hardwood species in Wyandotte, Leavenworth, Atchison and Doniphan counties.

The white oak is a very desirable tree for park plantings. Its leaves throughout the summer are a dull green on the upper surface and silvery gray beneath, changing to wine color in the fall and persisting well through the winter. It gives a pleasing variation in color in mixture with other hardwood species.

THE POST OAK (*Quercus stellata*). This is a common tree on dry gravelly uplands in the Mississippi basin and throughout the limestone hills and sandy

plains of Texas. Its natural range extends from Massachusetts westward to eastern Kansas and Oklahoma and southward to Florida.

Under the most favorable conditions it attains a height of approximately 100 feet, with trunks measuring 2 to 3 feet in diameter. In Kansas it is a small-sized tree, seldom exceeding 30 or 40 feet in height or more than 15 or 18 inches in diameter. In this state it is found growing only on dry gravelly ridges and in almost wholly a pure stand.

It is seldom if ever used for street or yard trees, excepting where it grows of its own accord. It is a tree of slow growth and not well suited for street or yard plantings.

FIG. 91.—A bur oak tree growing in St. George, Kan. This tree is possibly 150 or 200 years of age. Having grown in the open, it developed a short stem and a broad, spreading crown. This tree is about 65 feet in height and its spread of limbs exceeds its height. The stem is nearly 5 feet in diameter. (*By Scott.*)

THE BUR OR MOSSY CUP OAK (*Quercus macrocarpa*). This species attains a larger size than any other of the oaks. A height of 150 feet or more with trunks 6 to 7 feet in diameter and clear of limbs to a height of 50 feet or more is not unusual. Its range of distribution exceeds that of any of the other oaks, extending from Nova Scotia and New Brunswick westward through the St. Lawrence river to Ontario and southwestward through Nebraska to the foothills of the Rocky Mountains of Montana, and southward to the Gulf states. It prefers low, rich, bottom soil, but does not confine its range strictly to this type. In Kansas this species is found throughout the eastern half of the state and it follows the watercourses well up through the northwestern part. It is a perfectly hardy tree and deserves greater consideration for all planting purposes than any other of the oaks. Under the most favorable growing conditions it is a stately tree. Under the more adverse conditions it is a pictur-

esque, snarly, rugged tree, long-lived and remarkably free from insect and fungus attacks, clean and free from debris and pleasing at all seasons.

THE CHINQUAPIN, CHESTNUT OR YELLOW OAK (*Quercus muehlenbergii*). This is another large-sized tree attaining a height of 80 to 100 feet under favor-

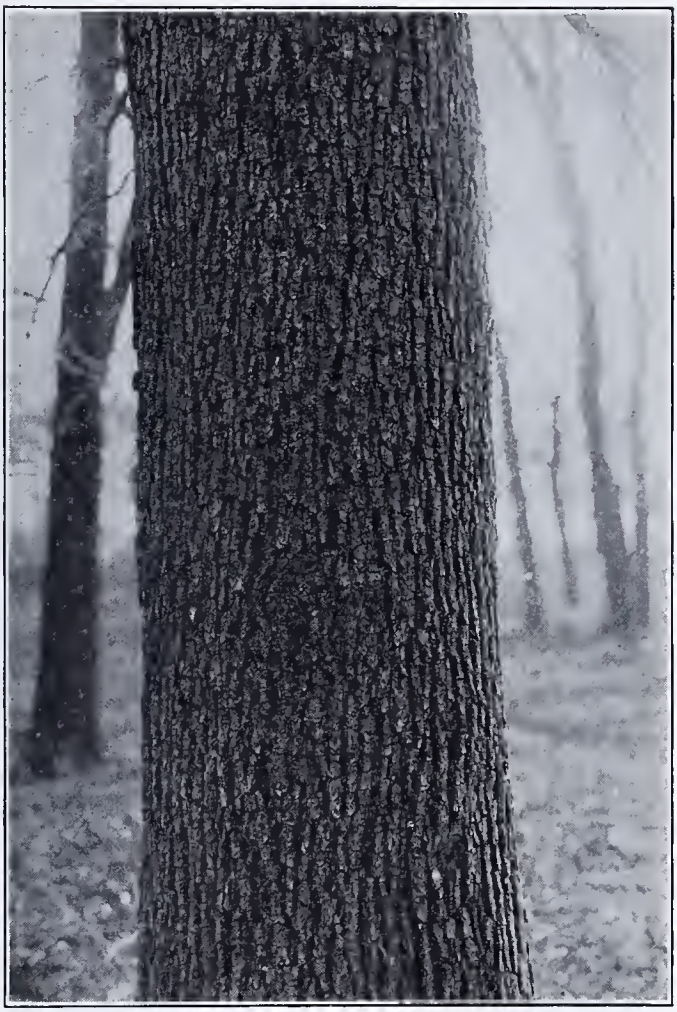


FIG. 92.—A stem of a bur oak showing the bark characteristics. The narrow ridges do not loosen or flake off. (*By Scott.*)

able conditions. Its range of natural growth is throughout the hardwood region of the Central states. In Kansas it is found growing commonly in the eastern half of the state. It is usually found growing on the hillsides and gravelly ridges bordering the watercourses. It is not a tree that has been used in Kansas plantings, nor does it deserve any consideration for such uses excepting as an additional species in a collection of trees.

The Dogwoods.

(*Cornus.*)

The dogwoods are small-sized trees or shrubs and are found growing throughout the hardwood regions of the Central states. Three or four species are indigenous to eastern Kansas. These are of no economic value excepting for ornamental plantings.

FIG. 93.—The smaller of the two trees in the center of this picture is a flowering dogwood. It is a fine specimen of this species. The large tree is a red oak. These trees are growing on the bank of Spring river near Baxter Springs, Kan. (*By Scott.*)

THE FLOWERING DOGWOOD (*Cornus florida*) is the largest of our native species. It is found only in the extreme southeastern part of the state, in the vicinity of Baxter Springs. It attains a height of 12 to 15 feet, and when in bloom it is a mass of white. In the Eastern and Southern states it is planted extensively as an ornamental shrub because of the beauty of its flowers. It is also very attractive in the fall because of the beauty of its autumn colors.

Cornus asperifolia. This species is common throughout the eastern half of the state. It seldom exceeds 10 feet in height. It is found commonly as a border shrub of the natural wooded belts and also extending farther up the draws and ravines than the larger trees.

THE RED BARKED DOGWOOD (*Cornus stolonifera*). This is a common species along ravines and in moist situations in the eastern third of the state. It is a shrub seldom exceeding 6 or 8 feet in height. The conspicuous feature of this species is the bright red color of the bark on the 1- and 2-year-old shoots. So striking is this that it is used extensively in ornamental plantings to give color to the mass of shrubbery during the late winter and early spring months.

The Button Bush.

(*Cephlanthus occidentalis.*)

The button bush is a small tree or large shrub of wide distribution. Its range is from New Brunswick to Ontario and westward to eastern Nebraska and Kansas, south to Florida and westward through Texas, New Mexico, Arizona and California. It attains its largest size in the swamps of southern Arkansas and eastern Texas, where it sometimes reaches a height of 40 or 50 feet. In Kansas it is a shrub that rarely exceeds 8 or 10 feet in height. It is a swamp-type species and is found growing only in swampy locations or along the margin of streams where an abundance of soil moisture is available.

It is a shrub that is very attractive in mixture with other species. The striking features are its balls of blossom clusters in early summer and the balls of seed clusters throughout the fall and early winter months. It derives its name from the balls or buttons of seed clusters.

The button bush is a very desirable shrub for park plantings where suitable soil is available.

It is propagated from cuttings and also from the seeds.

The Elderberry.

(*Sambucus canadensis.*)

This is the common elderberry that is found throughout the eastern half of the state. It is a shrub that seldom exceeds 8 or 10 feet in height. Its growth is confined to deep, rich soil. It usually occurs in dense clumps. It is propagated by roots, shoots, cuttings and by seeds. In the northeastern part of the state it is a pest in cultivated fields. It is sometimes planted as an ornamental shrub. The blossoms occur in large, white heads that are very showy. The flowers, however, are ill-smelling and the shrubs should not be planted near dwellings. The fruit begins ripening by midsummer and continues coming on until frost. The fruit is edible and is often used as an ingredient for pies and jams and the juice makes a very refreshing drink. This species has a wide range of distribution extending from the lake states to the Gulf and from the east coast to the plains.

The Viburnums.

The viburnums are small-sized trees or shrubs found widely distributed throughout the hardwood region of the United States. Three species of the viburnum are found growing naturally in Kansas. They are:

1. *Viburnum lentago,* the sheepberry or nannyberry.
2. *Viburnum prunifolium,* the black haw or stag bush.
3. *Viburnum rufidulum,* the black haw.

These are all shrubs seldom exceeding 10 or 12 feet in height. All are found in the southeastern section of the state growing along the margin of woodlands. They prefer dry, rocky soil along the margin of streams and fence corners. They are sometimes used as ornamental shrubs. Their use for this purpose should be encouraged. They are propagated entirely from seeds.

THE WOOD LOT.*

The care of the wood lot is an important item in farm management that has received but little attention in this state. Every acre of natural or planted timber growing on Kansas farms should be a source of income and profit to the

FIG. 94.—Sawing lumber from a Shawnee county, Kansas, wood lot.

farm. The products from the wood lot are saw logs, railroad ties, poles, posts, fuel wood and nuts.

The saw logs from the Kansas wood lots furnish excellent lumber for interior use in farm buildings. It is especially serviceable for joists, beams, studding, and sheathing for houses, and for floors and partition boards for bins and stalls in barns and sheds. For such uses our native lumber is more durable and more satisfactory than the pine lumber from the local lumber yard. A great many of our native logs are sawed into box boards and crating material at the local mills, and command a good price for such uses. In some sections of the state the native logs are in good demand at barrel-head and stave factories. The cottonwood is recognized as one of the very best woods for staves for flour, vegetable and fruit barrels. The elm, hackberry, ash and soft maple are used extensively for barrel headings. The black-walnut logs are considered

* From the Twentieth Biennial Report of the State Board of Agriculture.

too valuable for local consumption, and the most of them are bought by wholesale walnut-log buyers and shipped to eastern consumers. Second-growth hickory is in good demand at vehicle factories, and the cordwood finds ready sale at good prices at the packing-house centers, where it is used in smoking cured meats.

There are no reliable figures available that show the amount or the value of the wood-lot products required annually, but the sum total for such a state as Kansas is immense. To understand fully the economic importance of the wood lot we must remember that the United States, as a nation, is cutting her timber supply at three times the rate of the growth of the timber in her forests, and that lumber prices are constantly and gradually advancing. This advance in price is bound to continue until the price of lumber equals the

FIG. 95.—A worthless, sandy hillside that was planted with jack pine in 1903. This picture was taken in 1907. Figure 96 shows the same hill as it appeared in 1915. (*Courtesy Forest Service.*)

price of stone, brick, tile and cement as building materials. These materials, and especially lumber, are bulky commodities, and the transportation rates greatly increase the cost to the consumer. All of these conditions increase the value of the products of the farm wood lot.

The term "wood lot" as used in this article includes all land within the state on which natural or planted timber is growing. There are approximately 500,000 acres of natural timber land within the state. This land is at present considered waste land by most of the owners, for the reason that the returns from it do not pay the taxes and a reasonable interest on the investment. The present stand of timber on this land is of little value, because of the fact that for the past fifty or sixty years the settlers and owners have gone into the wood lot from year to year and cut the best trees for their particular needs, and have left such kinds as the white elm, the hackberry, the soft maple, the sycamore, the basswood, the water oak, and like worthless species. These, because of their hardiness and ability to compete with other native vegetation, now occupy the ground that might well be producing such trees as the black walnut, bur oak, cottonwood, red cedar, or Austrian pine.

The problem to be solved in handling the wood lot is, How can the stand of trees be improved and the yield increased? If we want to grow a crop of corn we plant the seed and cultivate the growing crop; if we want to grow good fruit we prune and spray the orchard; if we want to grow high-grade lumber-producing trees we must choose the valuable kinds, plant and care for them as their demands require.

In the eastern half of the state the natural timber is found on three distinct types of land—the overflow land lying along the rivers and their tributaries, the steep hillsides facing these watercourses, and the gravelly and sandy land found in certain sections of the state. By far the greater area of this is included in the first class mentioned, viz., the overflow lands lying along the watercourses. This is the richest land within the state, capable of producing

Fig. 96.—The same hill that is shown in figure 95. This picture was taken in 1915.

timber that will, under proper management, return a good profit and interest on the value of the land. The trees that are best adapted for such land are the cottonwood, black walnut, bur oak, and pecan.

The rough hillsides and steep slopes now supporting an unprofitable stand of black and red oak, hickory, ash, and other similar growth, are capable of supporting a profitable growth of trees if the right species are planted. The trees that are peculiarly adapted to this type of soil are the native red cedar and the Austrian pine.

The gravelly and sandy land that is now occupied almost exclusively by post oak and blackjack is a very poor type of land, entirely unfitted for agricultural purposes. The post-oak land is too gravelly and sterile to produce agricultural crops, although when cleared it makes fair grazing land. When cleared and farmed the blackjack land soon becomes exhausted of its fertility and blows and drifts with the prevailing winds. Both of these types of land are capable of producing excellent tree growth when the right species are planted. The trees suitable for these soils are the red cedar, Austrian pine, and Chinese arbor vitæ.

The kind of land and the character of the growth upon it must determine

the details of the method to be employed in the improvement of the wood lot. However, the general system will be the same in all cases, and will consist of three distinct operations:

First. Thinning: cutting out all mature trees that are worth as much now as they will be at any future time, and all undesirable trees of all ages or sizes.

Second. Planting: restocking the land by planting seedling trees or seeds of desirable species.

Third. Protecting the young trees against injury from excessive growth of weeds, fire, or live stock.

FIG. 97.—Clearing, burning brush, digging holes, and generally putting the land in shape for tree planting. (*Courtesy American Forestry.*)

THINNING.

The first step involves the greatest amount of work and possibly the greatest amount of expense. All the mature trees should be cut to make room for the smaller-sized trees now growing together with them, and to make room for planting seeds or seedlings of desirable trees for future crops. The undesirable trees of the present stand, regardless of their age or size, should also be cut so as to make room for as many trees of the more valuable species as possible. The cutting may be done by one of two systems—the *group* or *strip* system. The group system consists of cutting the trees in groups of irregular areas here and there throughout the wood lot. One or more groups are cut each year until the entire wood lot has been cut over. This system will probably be found to be the most satisfactory in the Kansas wood lots

The strip system consists of laying off the wood lot in a definite number of strips of varying widths, and of cutting one strip a year until the entire wood lot has been gone over.

PLANTING.

In order that the wood lot may yield the greatest possible crop of wood the land must be kept fully stocked with growing trees. The number per acre will vary with the age and size of the trees. Prof. E. L. Sponsler, University of Michigan, is authority for the following table, which gives the number of trees at different sizes necessary to keep the ground fully stocked:

FIG. 98.—A force of men planting evergreen seedlings on cut-over land. (*Courtesy American Forestry.*)

TABLE 1.—*Number of trees per acre required for a full stand.*

Diameter.[1]	No. per acre.	Diameter.[1]	No. per acre.
2 inches	2,000	14 inches	130
4 inches	900	16 inches	100
6 inches	510	18 inches	85
8 inches	320	20 inches	75
10 inches	235	22 inches	65
12 inches	170	24 inches	55

To give a clearer idea of the spacing of trees in a full stand, the following table gives the number of trees per acre for the different spacings.

1. The diameter of a tree is measured at 4½ feet above the ground.

TABLE 2.—*Number of plants required to set an acre of ground at the given distances.*

Spacing.	No. of plants.	Spacing.	No. of plants.
3 by 7 feet	2,074	12 by 30 feet	121
4 by 5 feet	2,178	15 by 30 feet	96
4 by 12 feet	907	18 by 24 feet	100
5 by 9 feet	968	20 by 20 feet	108
6 by 8 feet	907	12 by 42 feet	86
7 by 12 feet	518	15 by 36 feet	80
8 by 10 feet	544	12 by 48 feet	75
9 by 15 feet	322	24 by 24 feet	75
10 by 15 feet	290	18 by 36 feet	67
10 by 18 feet	242	12 by 60 feet	60
10 by 20 feet	217	15 by 48 feet	60
10 by 24 feet	181	24 by 30 feet	60
15 by 18 feet	161	15 by 54 feet	53
10 to 30 feet	145	18 by 42 feet	57

The planting may be done at any convenient time after the thinning has been done. The best time and the best method to follow will be determined by the character of the ground and the kind of trees that are to be planted. Walnuts and acorns may be planted in the fall, soon after they ripen or early the following spring,[2] in holes 4 or 5 inches deep, made with a spade or mattock. Enough nuts or acorns should be planted to insure a stand of not fewer than 2,000 seedlings per acre. This will require a plant on every 20 square feet of ground or on an area 4 by 5 feet in extent.

If seedlings are used in restocking the wood lot they should be planted in March or April. These should be planted in sufficient numbers to insure a full stand of trees. (See table No. 2 for spacing.) Because of the stumps and roots that are in the ground a regular spacing cannot be made, but enough trees can be planted to insure a full stand. Seedlings of the broad-leaved[3] species from 3 to 8 feet in height, and evergreens[4] from 15 to 24 inches in height will give best results. These must be planted in holes, dug with a spade, large enough to receive the roots spread in natural order.

The reason for planting the seeds and seedlings so much thicker than the trees can grow is in order to shade the ground as soon as possible, so as to keep down the weeds and to protect the ground from the drying effects of the sun and wind, and to develop trees with tall, straight stems, clear of large limbs to as great a height as possible. When not crowded trees develop short stems that divide into several large limbs near the ground, and are of little or no value for lumber, poles or posts.

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2. Whenever nuts or acorns are held over for spring planting they should be stratified soon after they ripen. Stratifying seeds of any kind consists of storing them in alternate layers with sand, soil, leaves or straw, so as to prevent overdrying or heating of the seeds. Small quantities of seeds are stratified in boxes that are stored over winter in basement rooms, or buried in pits out of doors; large quantities of seeds are stratified in bins in basements. It is usually desirable to allow the stratified seeds to freeze and thaw throughout the winter with the changes of the weather.

3. The term "broad-leaved" is applied to all forest trees excepting conifers or cone-bearing trees.

4. "Evergreens" is a term generally applied to conifers, and is used to mean conifers in this article.

FIG. 99.—Planting a pine tree in a cut-over wood lot. The short growth of brush will protect the pine from the sun and wind. (*Courtesy American Forestry.*)

FIG. 100.—Hauling black-walnut logs from the wood lot to the railway station. (*By Dickens.*)

PROTECTION.

The first attention that newly planted trees will demand will be protection against weeds, which if not cut will overtop and shade them out. This protection should consist of cutting the weeds from an area of ground extending at least two feet in all directions from the tree. If all the weeds can be cut from among the trees so much the better. When only a part of the weeds are cut there is danger of fire during the fall, winter, and early spring months. Young trees are easily killed by fire, and protection against this source of danger is very necessary.

Young trees are seriously injured and often killed by live stock trampling the ground and eating the leaves and twigs. It is therefore necessary that live stock of all kinds be excluded from the land growing young trees. This protection must be maintained until the trees are large enough to shade out the weeds and their tops high enough to be out of reach of live stock.

DESIRABLE TREES FOR KANSAS WOOD LOTS.

Black Walnut.

The black walnut is a native tree throughout the eastern half of the state of Kansas and is the highest-priced wood on the market of any of our commercial American trees. The wood is used in the United States as shown below.

FACTORY USES OF BLACK WALNUT.[5]

Purpose.	Per cent.
Sewing machines	33
Musical instruments	21
Millwork	19
Furniture and fixtures	10
Firearms	7
Caskets and coffins	2
Electrical machinery and apparatus	2
Vehicles	2
Car construction	1
Other uses	3
Total	100

In recent years the best grades of black-walnut logs have largely been exported to European countries. However, the demand for walnut for American uses has greatly increased during the past few years. Black-walnut furniture and finishing is now becoming very popular in the United States. The present prices of walnut logs vary, according to the size and quality, from $50 to $150 per 1,000 board feet on the stump.

Range and Habit of Growth. The black walnut grows naturally throughout the hardwood region of the United States in mixture with other hardwood species. It is never found growing in pure stand, nor has it made an altogether successful growth when planted in pure stand. The black walnut is a tree which requires full sunlight, and should be planted only in mixture with trees of smaller size. The foliage of the walnut is rather sparse. This allows sufficient

5. The tables of factory uses for the various woods given in this article are taken from Kellog's "Lumber and Its Uses," published in 1914.

light to reach the ground to support a very satisfactory growth of the more tolerant[6] or shade-enduring species, such as the red cedar, the green or white ash, and the mulberry. The black walnut requires a deep, rich soil in which to make its best growth. Frequent flooding is not seriously objectionable, but the trees will not stand swampy conditions. Being highly intolerant as seedlings, they must begin their growth in the open. Under these conditions they make a rapid height growth, clearing themselves of limbs readily. By the time they have reached middle age they have attained their full-height growth, and

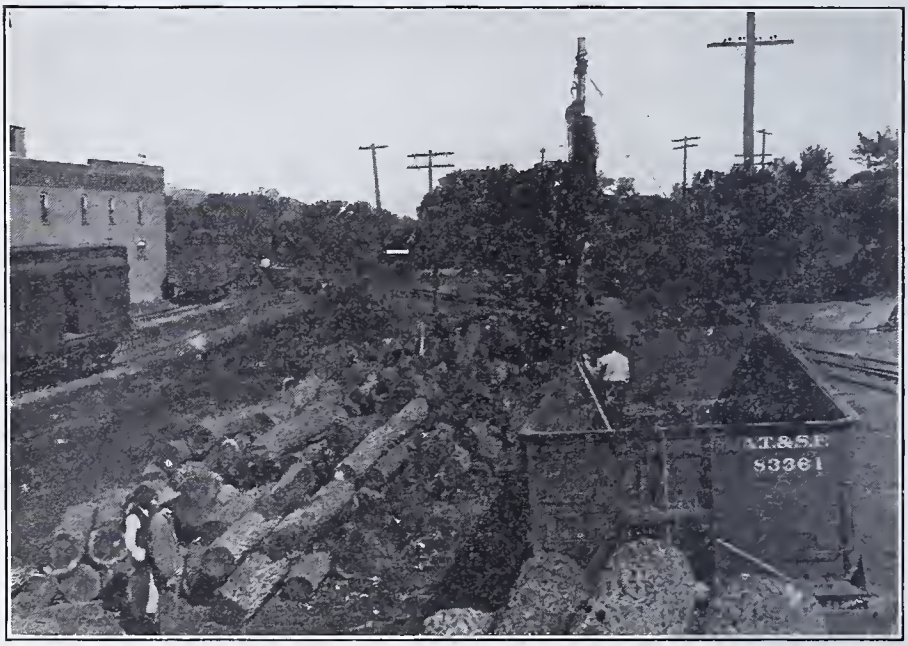

FIG. 101.—Loading black-walnut logs on cars, Manhattan, Kan., to be shipped to Eastern markets. (*By Dickens.*)

they must then have sufficient room to develop a broad, spreading top, in order to make a rapid diameter growth. The black walnut will reach its financial maturity[7] in from 75 to 100 years, at which age the tree should measure from 2½ to 3 feet in diameter at the stump.

The Yield. While no data is available to show what yield a full stand of black-walnut trees will cut, it is reasonable to expect that a stand of 50 trees per acre will at maturity yield not less than 5,000 feet board measure[8] of merchantable logs,[9] which at present value would be worth, at the very least, $250. This is equivalent to a rental value of $2.50 per acre per year gross income on a 100-year rotation.[10]

6. Tolerance of trees refers to their ability to grow in the shade of other trees. A tolerant tree is a tree that will grow thriftily in the shade of some larger tree. An intolerant tree is one that demands full sunlight and will not live in the shade of other trees.

7. Trees attain their financial maturity when the value of their annual growth falls below the cost of maintenance.

8. One foot board measure is the unit of measure of lumber, and it is a board 12 inches long, 12 inches wide, and 1 inch thick.

9. Merchantable log is a log that is salable on the market.

10. Rotation is the length of time required to grow trees to merchantable size.

Cottonwood.

The common cottonwood is a native through the entire state. It grows the most rapidly and attains the largest size of any of our native species. The wood is light, tough, quite strong, and entirely serviceable for many purposes. It is most commonly used in this state for rough lumber for interior purposes. It is used especially for joists, studding, flooring for bins and mows, stall partitions, and sheathing. In the commercial trade it is used extensively for boxing and crating and for the manufacture of excelsior and fiber for plaster mills. The present price of cottonwood logs on local market is about $12 per 1,000 board feet.

FACTORY USES OF COTTONWOOD.

Purpose.	Per cent.
Boxes and crates	56
Excelsior	14
Vehicles	9
Mill work	6
Agricultural implements	4
Woodenware and novelties	4
Furniture and fixtures	2
Refrigerators and kitchen cabinets	1
Other uses	4
Total	100

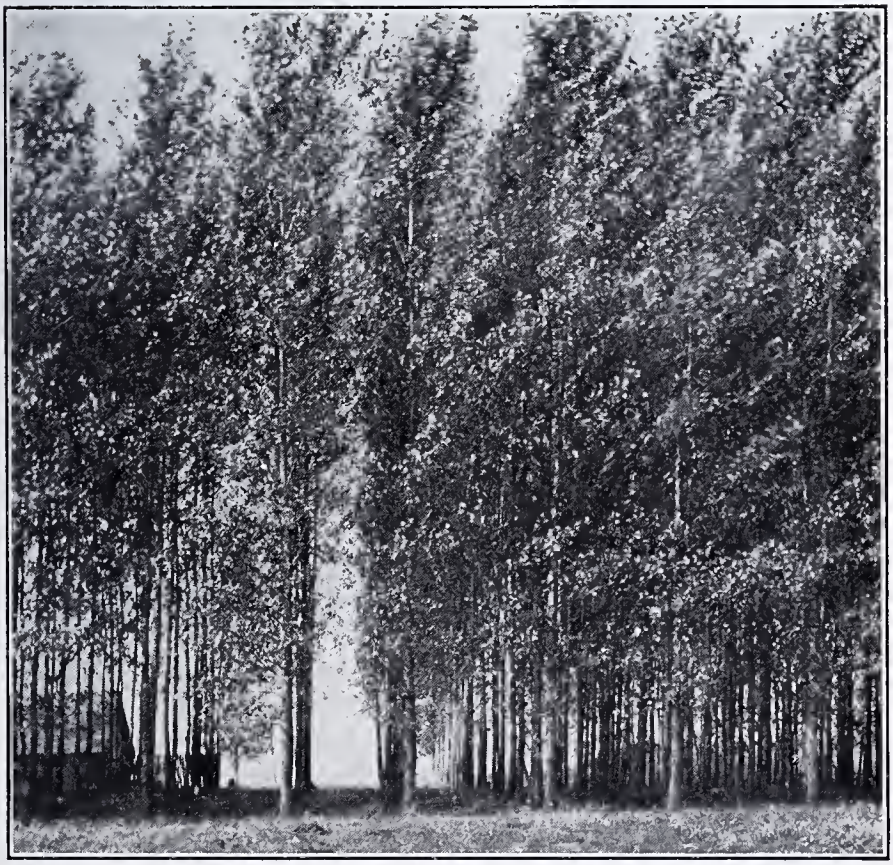

FIG. 102.—Fine grove of cottonwoods 10 years old, on low ground. Boles unusually straight and clear. Planted 5 by 6 feet apart; thinned to 6 by 10 feet. (*Courtesy Forest Service.*)

Range and Habit of Growth. The cottonwood is found growing naturally through the southern Mississippi valley region. It is found in great abundance along the watercourses and on low, rather wet soils, growing in mixture with hardwood species. The cottonwood requires full sunlight for its best growth.

FIG. 103.—A cottonwood (in the background) showing fine form. This tree will cut three saw logs, each 14 feet long, and all clear of limbs.

On account of the sparseness of its foliage it is a tree that will allow underplanting of some of the more tolerant species, such as the red cedar, mulberry, white or bur oak. The cottonwood will grow successfully in any soil in which there is an abundance of moisture, but it makes its best growth in deep, rich soils. Under these conditions the trees make a very rapid height growth, clear-

ing themselves of limbs readily, and at 20 years of age will have practically attained their height, which will vary from 75 to 100 feet, depending upon the strength of the soil. From this time on the rate of growth in diameter is quite rapid, until the trees are from 35 to 45 years of age. At 20 years of age some saw logs can be cut from the stand, but the majority of the trees will not reach merchantable size until 30 years of age. The maximum yield is attained when the trees are about 40 years of age. The following growth and yield table for cottonwood is taken from Bulletin 24 of the United States Department of Agriculture. The data from which this table was compiled were gathered from 1950 sawmills located throughout the Mississippi valley region.

FIG. 104.—Lumber cut from cottonwood logs from a planted farm wood lot in Reno county, Kansas.

Growth and Yield Table of Cottonwood in Pure Fully Stocked Stands in the Mississippi Valley.

AGE OF TREE IN YEARS.	Number of trees per acre.	Average D. B. H.* inches.	Average height in feet.	Yield per acre.	
				Stem wood.	Board feet.
5	.....	2.0	22	650	.....
10	699	5.7	56	1,800	.....
15	276	9.2	81	3,850	2,400
20	163	12.3	97	4,900	6,600
25	114	15.0	108	5,450	11,900
30	80	17.4	115	5,825	20,300
35	59	19.7	121	6,150	29,400
40	49	22.0	127	6,425	31,000
45	42	24.2	132	6,675	29,500
50	32	26.5	136	6,900	29,400

* The initials D. B. H. mean "diameter breast high," which is 4½ feet above the ground level.

Yield. The cottonwood will probably return the greatest financial yield per acre per year of any tree that is suitable for wood-lot planting. As shown in the accompanying table, a normal yield at 40 years of age is 6,000 board feet per acre, which at $12 per thousand is $72 per acre, equivalent to a rental value of

$2.40 per acre per year. There is no other species that can be planted in this state that will yield more than half this amount of lumber in the same length of time. Because of its rapid rate of growth it requires less attention and cultivation than any other tree. It is a tree that is comparatively free from

FIG. 105.—A fine stand of second-growth oak. This wood lot will at some future time cut a lot of good logs, poles, posts and fuel wood.

FIG. 106.—White-oak and red-oak logs at mill, having been shipped by rail from farm wood lots a distance of about 20 miles. (*Courtesy Forest Service.*)

injurious insect attacks or from fungous diseases until it has reached maturity. The demand for the cottonwood lumber is good and will continue to increase. Inasmuch as it is a lumber that can be used generally on the farm, it merits a place in every farm wood lot for the production of farm-timber supplies.

Bur Oak.

The bur oak is native throughout the hardwood region of the United States, and is found growing naturally throughout the eastern half of Kansas. On favorable soil and in protected locations it can be grown very successfully in the wood lots. The wood of this species is hard, heavy, strong and very durable in contact with the soil when thoroughly seasoned. It is a wood that can be used in almost every way on the farm, makes excellent posts, framing timbers, bridge planks, railway ties, and material for general repair purposes.

FIG. 107.—White and red oak, and some hickory, from small farm wood lot. (*Courtesy Forest Service.*)

The mature trees are in demand for lumber purposes. It is one of the valuable woods for factory uses, which are as follows:

FACTORY USES OF OAK.

Purpose.	Per cent.
Furniture and fixtures	32
Millwork	25
Car construction	15
Vehicles	11
Agricultural implements	3
Boxes and crates	3
Ship and boat building	2
Refrigerators and kitchen cabinets	1
Musical instruments	1
Sewing machines	1
Other uses	6
Total	100

Range and Habit of Growth. The bur oak grows in mixture with the other hardwood species. It is seldom found growing in pure stand. As a seedling it will endure considerable shade, but it requires light from above to develop

its best form and to make its most rapid growth. When grown in thick stands as saplings they develop tall, straight stems with few limbs. By the time the trees reach middle age they demand full light, and with the approach of maturity develop broad, spreading crowns with massive trunks. The foliage of the bur oak is very dense and allows but little light to strike the ground. To make its best growth it requires a deep, rich, fresh soil, but grows remarkably well on rather heavy gravelly soils. Being tolerant in youth, the acorns of this species may be planted in partially shaded situations, especially where the shade is from the side rather than directly overhead. When grown in the open with full light the bur oak develops a short trunk with many heavy limbs. This type of tree is of little value except for fuel and posts. The best form of oak is always developed in dense stands or in partly shaded situations. The bur oak will reach maturity in from 75 to 100 years, at which age the trees should be from 2½ to 3 feet in diameter at the stumps.

Yield. There are no figures available to show what yield may be expected from a full stand of bur oak. However, the cut in logs at maturity should be not less than 5,000 board feet per acre. The present stumpage price varies from $12 to $25 per 1,000 board feet. As the oak is a valuable post timber, no doubt the greater part of it will be used for posts and ties.

Pecan.

The pecan is one species of hickory, which grows naturally throughout the southeastern fourth of the state. While the wood of this tree is not considered of any great commercial value, the nuts that the tree produces command a good price, and under proper care the trees yield a good crop, which in many instances will equal or exceed in value the agricultural crop that may be produced on land suitable for growing pecans. The soil along the watercourses in the southeastern fourth of the state is entirely suitable for pecan growing, and many farmers are now considering the possibility of growing such a crop.

An investigation of the conditions under which pecans grow most successfully shows that the trees are well adapted to a variety of soils, but that they make their best growth and attain the largest size on deep, rich, moist soil. They will grow in swampy conditions, but prefer a well-drained soil. Trees have been found growing on dry, gravelly or stony soils, but in such soils their rate of growth is slow and the trees are small and scraggly in appearance.

Up to this time but very little has been done in this state to determine what is possible in the way of developing an improved strain of our native pecans. There are great possibilities along this line. The so-called paper-shelled pecans of the South are not hardy under our conditions and cannot be used for planting stock. The nuts of our native species are small in size, but the quality is excellent. The shells of some of our native nuts are extremely heavy, while on others the shells are very thin, comparing favorably in thinness with the so-called paper-shelled nut of the south. A careful survey of the state would undoubtedly reveal some unusually large nuts with medium or thin shells, from which seedlings from the ordinary nuts might be budded.

If a desirable nut can be developed in this way there is a great possibility of growing pecans profitably on large areas of overflow land along the Marais des Cygnes, the Neosho and the Verdigris rivers and their tributaries. The pecan trees in this section of the state, growing under natural conditions, fre-

quently attain a diameter of 3½ of 4 feet, and vary from 75 to 90 feet in height. Mature trees are known to have yielded as much as 600 pounds of nuts in a single season. However, the nut crop under natural conditions occurs periodically. There are a few nuts practically every year, and occasionally there are extremely heavy crops.

System of Management. The pecan is propagated from the nuts. These should be planted in the fall or stratified until spring and planted in March or April before they begin their growth. The ground in which the nuts are to be planted should be under a thorough state of cultivation. The nuts should be planted in rows or at regular spacing at the rate of from 3,000 to 5,000 per acre. When 2 years of age the seedlings should be budded with buds from the best stock available. This work should be done during August. The following spring the tops should be cut off the seedlings on which the buds have set. The bud then throws out a shoot which develops into the future tree. When 5 years of age the budded trees are transplanted to their permanent location. Cultivation must be continued until the trees reach such size as to thoroughly protect the ground by their shade. Some authorities on growing pecans maintain that cultivation should continue as long as the trees live and that the size and quality of the nut is greatly improved by continuous cultivation. Cultivation at least maintains a better supply of soil moisture than it is possible to maintain without tillage.

At 12 to 15 years of age the trees come into bearing and at 20 years of age should produce enough nuts to be of considerable value, the quantity of nuts continuing to increase with the increase of the size of the tree. The land on which pecans are most likely to yield a profitable crop is the overflow land along the streams mentioned. Flood waters are in no way harmful to the growing trees, after they have reached sufficient size not to be completely submerged. Agricultural crops on this character of land are very uncertain, and because of their uncertainty grain farming is not a profitable enterprise.

Value of the Nuts. The market price of the nuts varies from year to year, presumably based upon the supply and demand. In years when the nut crop is heavy prices go down; when the nut crop is light the price advances. The range of fluctuation is from 15 to 20 cents per pound on the local market. Selected strains would produce nuts of uniform size and shape, and would, because of the cultivation given the tree, be larger than our common nuts and would command a better price. The selling price of the so-called paper-shelled pecans of the South which are from one-third to one-half larger than our native species, is from 30 cents to $1 per pound.

The local supply of nuts is bought and used by wholesale confectionery concerns located in St. Louis and Chicago. The shelled pecans found on our local market are nuts of some of the improved budded varieties, mostly from Texas, some of the more hardy of which it may be possible to grow successfully in this state. Those that are most likely to give satisfactory results are the Busseron, Indiana, Niblack, Major and Warwick. These varieties are being grown successfully as far north as southern Indiana and Illinois.

The value of any nut meat of the pecan depends largely upon separating it from the shell without breaking or crushing the meat. In order to remove the shell with the least danger of injury to the kernal, the nuts should be steamed or steeped for a few minutes in hot water. This softens the shell and

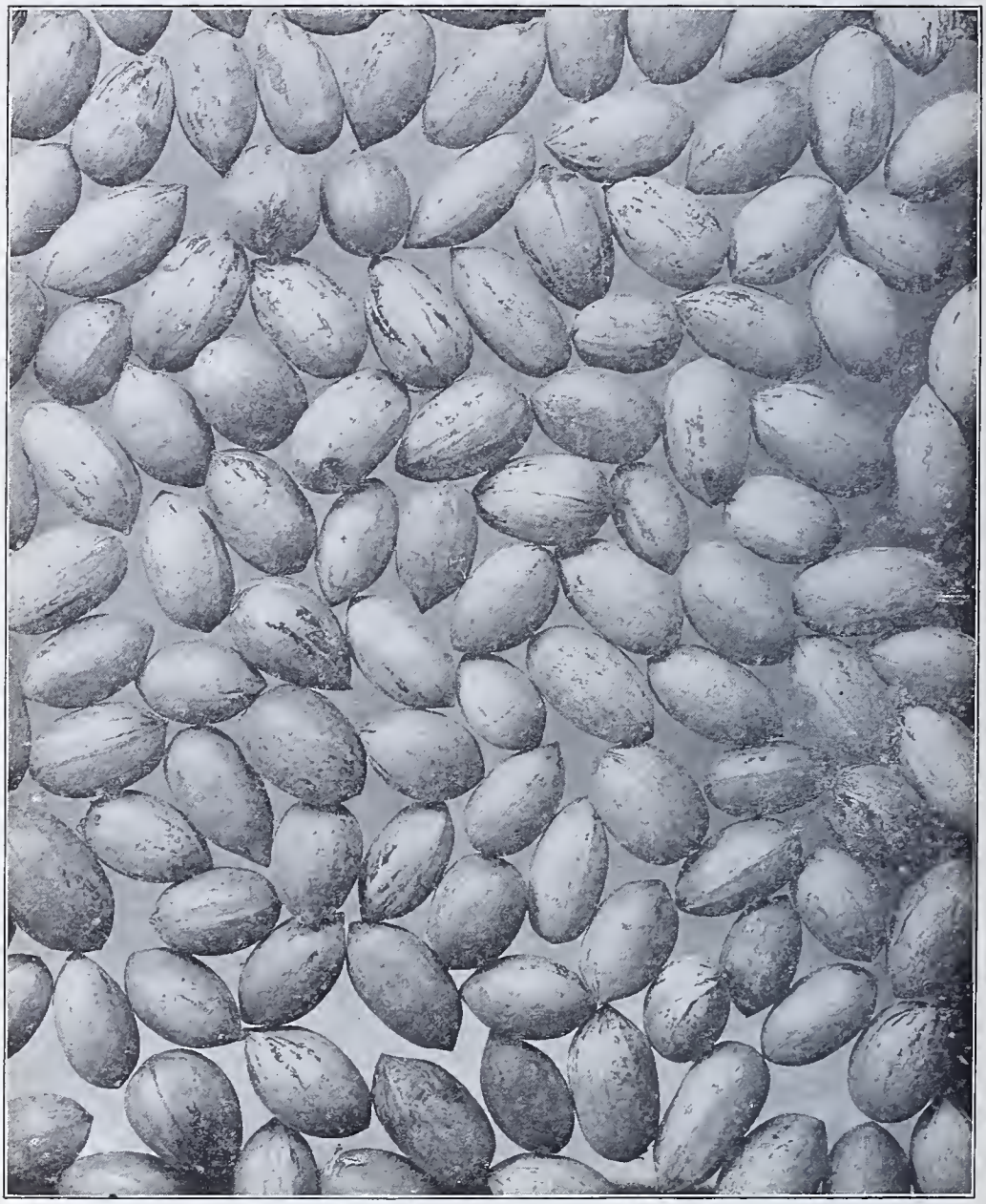

FIG. 108.—Nuts from pecan trees growing in Kansas.

makes the nut meat more pliable and greatly reduces the danger of cracking or breaking it when removing the shell. There are a number of nutcrackers on the market. Among these the Squirrel, the Perfection, the Eureka, and the Bostrom are improved types that crack the shells very satisfactorily without seriously injuring the nut meats. Steaming or steeping the nuts, however, adds greatly to the ease with which the shell can be cracked and separated from the meat.

Use of Nuts. The use of nut meats in American homes has greatly increased in the past ten or twelve years. They are used extensively in nut loaf, in bread, in salads and as an article of diet. However, the greatest use for the meat of the nuts is found in the wholesale confectionery trade.

FIG. 109.—Grove of pecans that yields heavy crops of nuts.

Red Cedar.

The red cedar is the only coniferous tree that grows naturally in this state. The wood is of special value for specific purposes. It is used exclusively in the manufacture of all high-grade lead pencils, which calls for absolutely clear wood. In recent years the cedar-chest industry has developed rapidly in this country, and a large quantity of inferior lumber, containing knots, sapwood and other defects that disqualify it for use as pencil wood, is used in this industry. Smaller-sized, knotty material, unfit for the cedar-chest industry, is used extensively as posts and poles. The red-cedar wood is the standard of durability of all native timbers. It is practically indestructible to decay. Cedar posts command a higher price than any other post on the market. The only criticism to the red cedar for this purpose is that it is not strong enough to resist a severe strain when the ground is frozen, and the

posts generally break off squarely at the surface of the ground at such times. During the months when the ground is not frozen they are absolutely satisfactory in every respect.

Range and Habit of Growth. The red cedar grows naturally throughout the greater part of the United States from Maine to Florida, and from Florida northwest across the plains states to the Rocky Mountain region and British

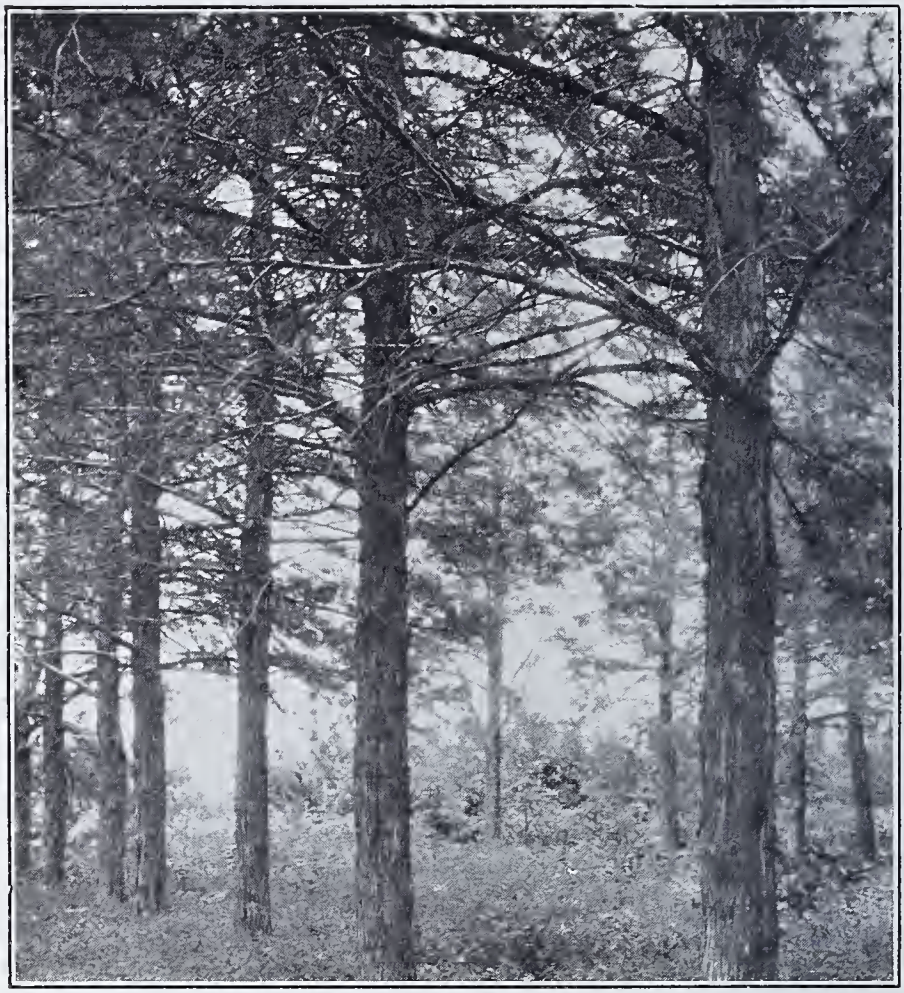

FIG. 110.—Red cedar trees in a farm wood lot. These trees are 42 years of age, and will cut 12 posts each.

Columbia. Throughout the New England states they are found growing on all types of soil, excepting in swampy, wet situations. In the Southern states they are a swamp-type tree. Throughout the plains states and the western mountain regions they are found occupying the bleakest and most exposed situations on north and northeast slopes. This range of habit indicates their adaptability to the various soils and conditions under which they will grow.

In this state we find the cedar in definite areas in different portions of the state, principally throughout the limestone section, and in some instances in

the districts having sandstone outcroppings. In these different districts the red cedar first gained foothold on the protected sites with north and northeast exposures, and since the trees have reached maturity and produced seed they have gained a foothold on practically all types of soil, and are now found growing abundantly over the tops of many of our limestone hills, as well as in the deep rich soil found in the bottom lands along the watercourses.

It is a tree that is found growing in pure stand only in the Southern states, and grows vigorously either in pure stand or in mixture with hardwoods. It is a highly tolerant tree during youth, but demands full sunlight by the time it reaches middle age. The foliage is very dense and will not permit of underplanting. Being intolerant from middle age on, the trees do not clear

FIG. 111.—Red-cedar posts grown in a farm wood lot. (*Courtesy Forestry Service.*)

themselves readily of limbs, and for this reason few clear stems can be developed except in very dense stands.

The green foliage of the cedar will burn as rapidly as the dry leaves of any other species, and once stripped of its leaves the tree will die. Little thinning will be necessary in a red-cedar stand until the trees have reached pole size, when it will be necessary to thin the trees in order to induce diameter growth. The material removed in such a thinning will make stakes and posts. The remaining trees will reach their financial maturity when between 50 and 75 years of age.

Yield. The ultimate product will be posts and poles. At the present time it is impossible to buy red-cedar posts on our local market excepting through special orders. A conservative estimate of the number of posts per acre at 50 years of age will be from 3,500 to 4,000 posts per acre. This is estimating the final stand to be spaced at 10 by 15 feet, and estimating that each tree will cut 12 to 15 posts, which is not more than can be expected. At 20 cents per post this gives a gross return of $700 or $800 per acre, equivalent to an annual rental of $14 or $16 per acre.

One great advantage in favor of the red cedar as a wood-lot tree in this state is that it is entirely adapted and suitable for planting throughout the entire state. There is not a quarter section of land in the state of Kansas on which red cedar cannot be grown successfully. It is the hardiest tree growing within the state. It has endured, without serious injury, the severest weather conditions that western Kansas has experienced in the past fifty years. It suffers less injury from hail and wind than any other tree that has been tried in western Kansas. The only objection that can be raised to the growing of red cedars in the woodlot is the fact that it is a host to a fungous disease known as the cedar apple, which in another form attacks and injures apple trees and fruit. It occurs on the apple leaf as rust and on the fruit as scab. However, this injury can be prevented by spraying with a fungicide, and inasmuch as it is impossible to grow apples in this state without spraying for both insects and fungous diseases, this fungus can be readily held in check with the same spray that is applied for other fungous diseases.

Austrian Pine.

The Austrian pine is an introduced species from Europe. It has been planted extensively throughout the eastern half of the United States, where it has grown with much vigor and has proved a very satisfactory tree for protection and ornamental planting. When planted in dense stands the trees clear themselves readily of limbs and develop straight trunks of good diameter. The wood is straight-grained, of moderate weight, strong, and makes a very satisfactory lumber. The Austrian pine is well adapted to planting in wood lots throughout the eastern half of the state.

Habit of Growth. The Austrian pine is an intolerant species, and must be planted in open situations where it will receive full sunlight. It attains its best growth and development in deep, rich, rather moist but well-drained soils. It grows remarkably well on light sandy soils or on thin, gravelly clay soils, but on the latter types of soil its rate of growth is considerably slower than on the bottom type.

The 3- and 4-year-old seedlings of this species, which will range from 15 to 18 inches in height, should be planted in pure stand, either on any cleared land or on old tilled fields or on steep gravelly or stony hillsides. These seedlings should be spaced approximately 6 by 6 feet, which will require 1,200 seedlings per acre. They will demand the same general care and attention that is required by other trees. By the time the trees reach middle age it will be necessary to do considerable thinning, at which time the inferior specimens should be removed. This cutting will yield considerable fuel, and perhaps some poles that can be utilized for other purposes. The final stand will reach maturity when from 60 to 75 years of age.

Yield. The ultimate cut will be saw logs that will measure from 18 to 35 inches at the stump. In good situations the yield should approximate 5,000 to 8,000 board feet per acre. In European countries the Austrian pine figures extensively in the turpentine industry. The bleeding is continued over a period of 12 or 15 years prior to the maturity of the crop and final cutting.

The Austrian pine is absolutely free from injurious insects and fungous diseases, and no objection can be raised to its use from these standpoints.

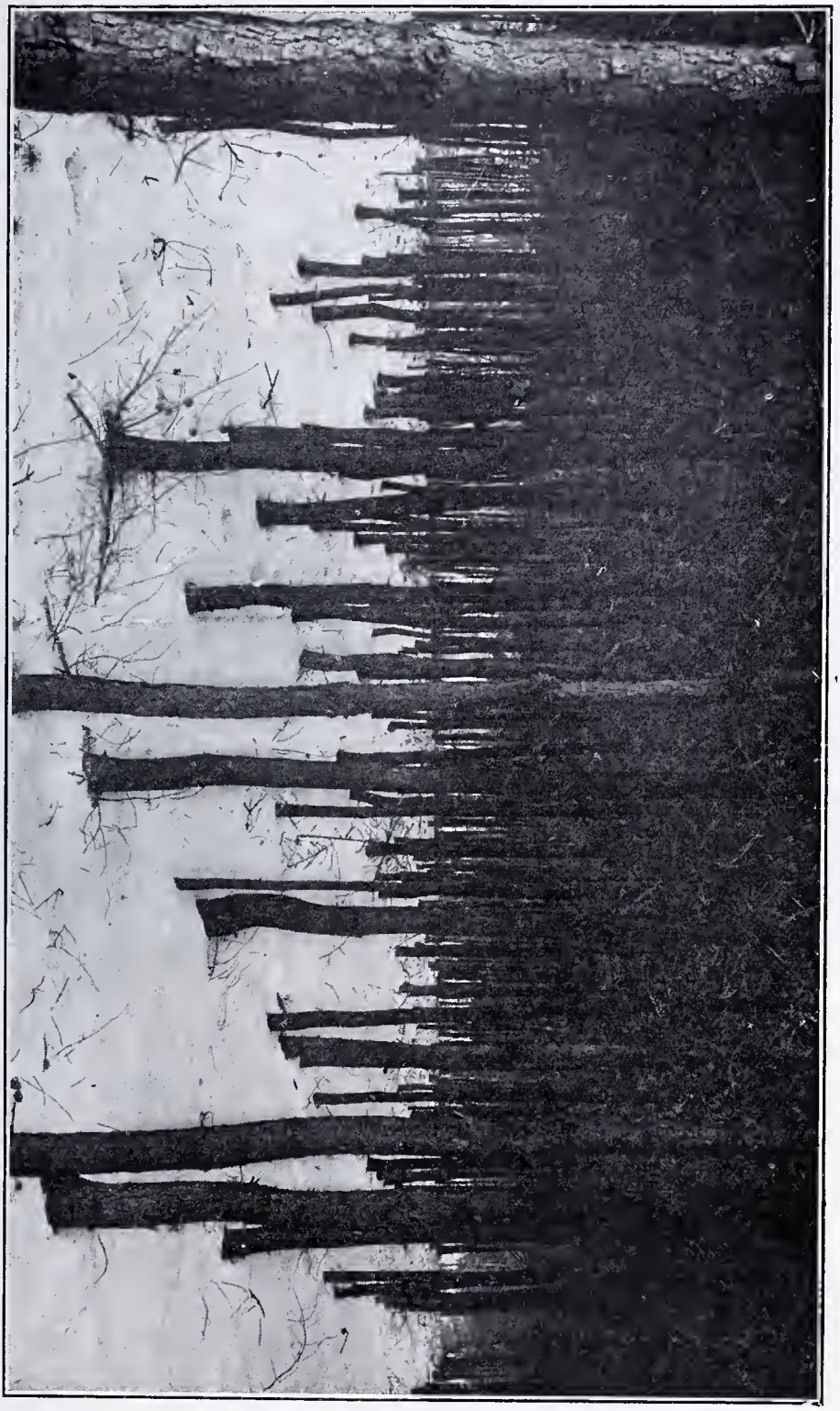

FIG. 112.—A 14-year-old pine wood lot. The trees are growing in poor clay soil. All the surface soil was washed or blown away while under cultivation. Originally this was prairie land in eastern Kansas.

The greatest objection at the present time to its use in the wood lots is the high cost of the planting stock.

Sugar Maple.

The sugar maple is a native tree along the eastern border of the state, and grows with much vigor on the rich, deep soils along the watercourses and up over the steep hillsides and bluffs on the eastern and northern exposures. This tree is a native through the greater part of the central hardwood region, growing in greatest abundance in the extreme north. The wood is heavy, hard, tough, strong, light-colored, and used extensively in the manufacture of furniture, interior finishing, flooring, and in many ways in the various industrial arts, as shown in the following table:

FACTORY USES OF MAPLE.

Purpose.	Per cent.
Millwork	34
Furniture and fixtures	17
Boxes and crates	10
Boot and shoe findings	6
Agricultural implements	5
Musical instruments	5
Handles	4
Woodenware, novelties, etc.	4
Vehicles	4
Laundry appliances	2
Other uses	9
Total	100

Habits of Growth. The sugar maple is one of the most tolerant of our broad-leaved species, growing as seedlings in dense stands under other hardwood trees, and even in mixture with conifers. In dense stands it clears itself readily of limbs and develops a narrow, conical crown, until it begins to approach maturity. The crown then assumes a more dome-like appearance, with compact, dense foliage. In this state the trees reach a diameter of 3 feet or more and a height of 60 feet or more. It is a tree that does not endure extreme heat or droughty conditions, and can only be grown successfully in this state where soil and atmospheric moisture conditions are congenial.

The 2- or 3-year-old seedlings of the hard maple may be used in wood lot planting to underplant maturing stands. When planted in this way the seedlings will require very little care, unless lopping the weeds is necessary to prevent the trees from being smothered. However, this will seldom be necessary if the stand is at all dense. In open stands hoeing and lopping the weeds will be required at least 2 or 3 years. Eight hundred or 1,000 seedlings per acre will give a very full stand of hard maple.

Yield. The principal returns from the hard maple will be that of sap for syrup or sugar, and the planting should be made with the idea of maintaining a sufficient stand to shade off lower limbs. Trees with full crowns and an abundance of foliage yield the greatest amount of sap, and the planting should be made with this object in view. One thousand trees per acre are entirely too many to allow to grow to maturity. When they begin crowding each other

fully half of the trees may be tapped and bled to death during a period of 3 or 4 years. These should then be cut out to make room for the remaining trees, which should grow until they reach a diameter of from 12 to 15 inches before tapping is begun. From this time on, by careful management, they may be bled annually without serious loss or injury to the trees.

No very definite data can be given on the yields from the maple industry, as so many factors enter into consideration. From 5 to 40 gallons of sap are obtained from a tree during a season; an average is somewhere between 10 and 20 gallons. Normal sap of an average year contains about 2 per cent of sugar, although it may vary from 0.5 per cent to as high as 7 or even 10 per cent. The sugar content varies greatly with the tree, its location and its past

FIG. 113.—A grove of sugar maple trees growing in Linn county, Kansas.

growth. A single tree will yield from 1 to 7 pounds of sugar per season, or expressed in syrup of standard density, from 1 pint to 1 gallon, though the average from year to year and from tree to tree is about 3 pounds of sugar or 3 pints of syrup. Expressing these data in other terms, it is seen that in a normal year 1 barrel of sap (32 gallons) should produce 1 gallon of syrup or 7½ pounds of sugar. In many camps and for many years it takes sometimes as high as 50 gallons of sap to make 1 gallon of syrup. First runs of sap are generally richer in sugar, hence take less for a gallon of syrup. From 6½ to 9 pounds of sugar, according to the kind, can be made from 1 gallon of standard syrup, with an average of 7½ to 8 pounds. A camp of 100 trees should produce about 40 gallons of syrup or 300 pounds of sugar during a season.

Chinese Arbor Vitæ.

The Chinese arbor vitæ is an evergreen tree, generally of low, compact growth in its native habitat—the dry, rocky mountains of northern China. When planted in good soil under favorable climatic conditions the trees attain a height of 60 feet and a trunk diameter of from 5 to 6 feet. They reach their best development in a deep, fertile soil, and they resist even a considerable amount of alkali. According to Chinese observations, these trees are known to live to an age of more than 2,000 years. The old specimens develop a very characteristic ragged and irregular outline, and are striking objects in the landscapes in northern China.

This tree thrives especially in those parts of China where the summers are hot and fairly dry, with an annual rainfall of between 15 and 25 inches, practically all of which falls during the months of July, August and September. The summer temperature in this region frequently reaches 110 degrees in the shade, while in the mountainous regions, where the tree grows under natural conditions, the winter temperature falls to 10 degrees below zero. The Chinese arbor vitæ will withstand a greater degree of cold than this if the winters are dry, but will not endure the cold in moist climates. The soil, moisture, and temperature conditions demanded by this tree prevail throughout the western two-thirds of the state of Kansas.

System of Management. The Chinese arbor vitæ is a highly intolerant tree, and the 2-year-old seedlings or transplants must be planted where they will receive full light from overhead. Methods of planting and protection of this tree are identical with those advised for growing the red cedar. It is a tree that can be used to a good advantage in the rocky, dry soils and steep hillsides throughout the eastern part of the state, and it is an especially valuable tree for planting throughout the western part of Kansas. When planted in dense stands of from 2,000 to 3,000 plants per acre, the trees develop tall, straight stems that make excellent posts and poles. When spaced more widely the trees develop rather broad, spreading limbs and are valuable for windbreaks.

There are two distinct forms of this species. One form grows erect with ascending limbs and is a valuable tree for the purposes mentioned. The other form is a dwarf type that grows very compact and symmetrical, and is prized highly for ornamental planting. It is one of the most beautiful of our ornamental evergreens. The two types are readily distinguishable in the nursery when the trees are two or three years of age, and the different forms should be selected and planted for the purposes they best fulfill.

In general appearance the tree is very much like the American arbor vitæ. The leaves are scalelike, closely appressed. Through the summer they are deep green, changing with the approach of winter to a rusty brown, again becoming a bright green during the first few warm days of spring.

Hardy Catalpa.

The hardy catalpa is a tree that has been planted quite generally throughout the state and most abundantly throughout the central section, where the well-cared-for plantations have proved very profitable. The wood of the catalpa is light brown in color and light in weight, but when seasoned is very durable in contact with the soil. Its principal use is for posts and poles.

Range and Habit of Growth. The hardy catalpa is found growing naturally

in southern Illinois and Indiana, western Kentucky and Tennessee, southeastern Missouri, northern Arkansas, western Louisiana, and eastern Texas. In its natural distribution it is a tree that frequently attains a height of from 60 to 80 feet, with a diameter often measuring 3½ or 4 feet. In Kansas it is a small-sized tree, seldom exceeding 40 feet in height or 2 feet in diameter. It is a tree that is well adapted to the soil and climatic conditions of the eastern half of the state, but it is not a tree that can be recommended for the western portion. It should be grown in pure stand and planted only in deep, fertile, cultivated soil. The soil requirements of the catalpa are similar to the soil requirements of corn, and any soil capable of producing a good yield of corn will product a good growth of catalpas.

System of Management. One-year-old seedling trees should be planted in rows 7 feet apart and set about 3 or 3½ feet apart in the rows. These may be

FIG. 114.—Eight-year-old catalpa trees in a farm wood lot in Sedgwick county, Kansas.

planted in alternate lister furrows. When set the roots may be partly covered with a spade by hand and the furrows later filled with a cultivator. The trees should be given at least two seasons' cultivation. Thorough cultivation during this time is very necessary to keep down the growth of weeds and to stimulate as rapid a growth of the trees as possible. By the third summer the trees should have attained sufficient size to shade the ground completely and to keep down all weed growth. Under these conditions they will make a rapid growth. When from 14 to 18 years of age they will have attained their financial maturity, and should then be cut. The cutting should be done in the winter and the ground should be cleared at one cutting. This will allow a growth of sprouts from the stumps to make a second crop, which in about twelve years will afford another cutting nearly equal to the first.

The Yield. The yield from a catalpa plantation will vary with the quality of the soil and with the care that the trees have received. On favorable soil, under this treatment, it is safe to count not fewer than 3,500 posts per acre when the trees are from 14 to 18 years of age.

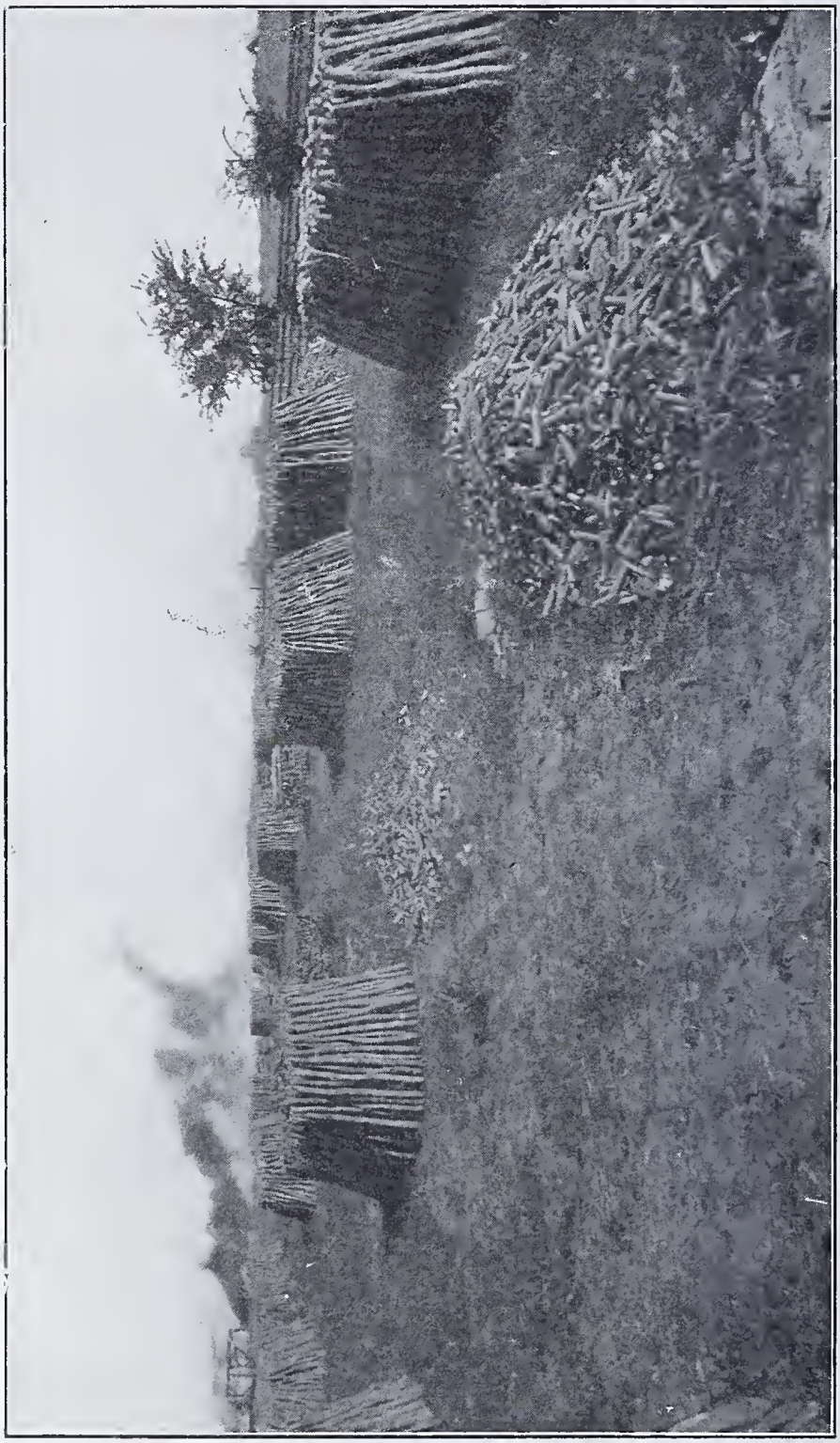

FIG. 115.—Partial view of wood lot; 60,000 catalpa fence posts and 650 ricks of stove wood from 20 acres of 16-year-old trees.

FINANCIAL ASPECTS.

The wood lot crop, unlike most other farm crops, requires a long period of years to reach maturity. Largely for this reason the importance of the wood lot has been overlooked. Few farmers appreciate the value of a stand of finely formed trees in their wood lot. Such a stand of trees in any wood lot, even though they are saplings, is an asset to the farm, and like a growing colt, represents a definite future value. Unless the waste land found on nearly every farm, that is more suitable for growing timber than any other crop, is utilized in this way, the land will continue to be unproductive for an indefinite time and will be a source of expense and detriment to the remainder of the farm.

The financial success of any wood-lot proposition depends upon three factors:

1. *The Initial Cost of the Undertaking.* As growing timber is a long-time investment, the first cost must be held down to a minimum or the interest on the investment will use up the possible profits. The cost of the planting stock is one of the first items to consider. This is a small item when nuts or acorns are to be planted, if a plan has been thought out. In seasons when heavy crops of nuts or acorns are produced the cost of the seed will be very little indeed, and the planting may be deferred until such a seed year occurs.

When seedling stock is used the plants may be grown in a home nursery or under contract by some commercial nurseryman.[11] The seedlings of the broad-leaved species are easily grown at but very little expense. The evergreen seedlings are more difficult to grow, and it is not advisable to attempt to grow these in a home nursery. Such stock when wanted in large numbers can be contracted for at a much less price than the quoted trade prices.

The cost of the actual planting of the nuts or the seedling trees is also an item of initial cost. This work must be planned so as to fit in with the regular schedule of the farm work. Plan to begin planting early in the spring before the other work demands full time of the working crew. This work should be organized so that there will be no loss of time when the planting crew is on the ground. In planting trees three persons usually work to the best advantage. One man can carry a supply of seedling trees and plant them about as fast as two men can dig holes in which to set them. The tools best suited for the work and the rate at which the holes can be dug will depend altogether upon the character of the soil. A crew of three men should plant from 3,000 to 5,000 seedlings per day, working eight hours.

2. *Care of the Growing Crop.* Cultivation and protection are absolutely necessary to insure a successful growth of the young trees, and the cost of this item must also be kept as low as possible; but it is work that must not be neglected or deferred until the weeds have sapped the vigor of the trees. Each year's planting should be limited to the acreage that can be cared for.

3. *The Harvesting.* This item is chargeable to the final cost and carries no compound interest, but the work must be well planned or it will be an expensive operation. This cost includes the felling of the trees, hauling the logs to market, or the cutting of the logs into lumber, as the case may be.

11. The state forest nursery will contract and grow seedling stock as cheaply as the farmer can grow it himself.

The cutting and hauling will cost from $2 to $6 per 1,000 board feet, depending upon the length of the haul. Cutting the logs into lumber will cost from $7 to $9 per 1,000 board feet.

Determining the number of board feet in a log is a matter with which few farmers are familiar. This is determined by established rules and practices among lumbermen. These rules and practices vary in different sections of the country and with different species of logs. The Doyle rule is the commonly used rule in this state. The logs should be cut about 4 inches longer than the even feet to allow trimming off weather-checked or broken ends. In the Doyle log table, which follows, the length of the log is given in feet

FIG. 116.—A portable sawmill. An equipment of this kind will saw from 5,000 to 7,000 board feet of lumber per day, and it is an economical method of converting logs into useful lumber.

in the top horizontal line; and the diameter, which is always measured inside the bark at the small end of the log, is given in the left-hand vertical column. The content of the log in the board feet is found at the intersection of these columns. For example, a log is 16 feet long and 22 inches in diameter inside the bark at the small end. By following down the vertical column under 16 until it intersects the horizontal column to the right of 22, we find the number 324. This is the number of board feet of lumber that can be cut from a log of the size given, according to the Doyle rule. The number of board feet in a log of any other size can be found in like manner.

Doyle's Log Table.

Diameter in inches.	Length in feet.										
	8	9	10	11	12	13	14	15	16	17	18
10	18	20	23	25	27	29	32	34	36	38	41
11	24	28	31	34	37	40	43	46	49	52	55
12	32	36	40	44	48	52	56	60	64	68	72
13	40	45	50	55	61	66	71	76	81	86	91
14	50	56	62	68	75	81	88	94	100	106	112
15	60	67	75	83	91	99	106	113	121	128	136
16	72	81	90	99	108	117	126	135	144	153	162
17	84	95	106	117	127	137	148	158	169	179	190
18	98	110	122	134	147	159	171	183	196	208	220
19	112	126	141	154	169	183	197	211	225	239	253
20	128	144	160	176	192	208	224	240	256	272	288
21	144	162	181	198	217	235	253	271	289	307	325
22	162	182	202	223	243	263	283	303	324	344	364
23	180	203	226	248	271	293	313	336	359	383	406
24	200	225	250	275	300	325	350	375	400	425	450
25	220	248	276	302	331	358	386	413	441	468	496
26	242	272	302	333	363	393	423	453	484	514	544
27	265	298	330	363	397	430	463	496	530	563	596
28	288	324	360	396	432	468	504	540	576	612	648
29	313	351	391	430	469	508	547	586	625	664	703
30	338	380	422	465	507	549	591	633	676	718	761
31	365	410	456	502	547	592	638	683	729	774	820
32	392	441	490	539	588	637	686	735	784	833	882
33	421	473	526	578	631	684	736	789	842	895	946
34	450	506	562	619	675	731	787	844	900	956	1012
35	481	540	601	661	721	781	841	901	961	1021	1081
36	512	576	640	704	768	832	896	960	1024	1088	1152
37	545	612	681	749	817	884	953	1021	1089	1157	1225
38	578	650	723	795	867	939	1011	1083	1156	1228	1300
39	613	689	765	842	918	996	1072	1149	1225	1302	1379
40	648	729	810	891	972	1053	1134	1215	1296	1377	1458

PART II.

HANDBOOK OF KANSAS TREES.*

By Frank C. Gates, Kansas State Agricultural College, Manhattan, Kan.

INTRODUCTION.

PERHAPS it is new to a great many people that Kansas is one of the extremely few states in the United States that has a larger area in forest than it did at the time of settling. The principal reason is probably the virtual elimination of the widespread forest fires previously set by Indians.

Likewise it will be surprising to many to learn that in most cases trees are much easier to study in winter than they are during other periods of the year. Further, the fairly open, usually mild winters that the state enjoys make a study of trees during the winter entirely feasible and thus add to the interest of the outdoors during that time of the year.

It is difficult to give a definition of a tree that entirely excludes the shrubs. There are species which at times appear to be shrubs, at other times trees. One way to separate them is to consider a tree as a woody plant with a single erect stem from the ground, whereas a shrub has many woody stems coming up, either from just below or at or a little above the surface of the ground. Some shrubs, if grown under crowded conditions, form erect stems which greatly resemble trees. In the present bulletin the plants that are included are considered unquestionably as trees in the majority of cases, although one should remember that as western Kansas is approached some of these species become more and more dwarfed and consequently more and more bushy or shrubby. In a few cases plants which are shrubs in Kansas, but are trees in the Southern States, are omitted. The following is a list of plants which, as far as known to me, are normally shrubs and not trees in this state. They are not described in this bulletin.

Cepholonthus occidentolis L. (buttonbush), in eastern Kansas.
Cornus osperifolia Michx. (roughleaf dogwood), in eastern Kansas.
Cotinus omericonus Nutt. (American smoketree), cultivated in eastern Kansas.
Evonymus otropurpureus Jacq. (wahoo), in eastern half or Kansas.
Ilex deciduo Walt. (winterberry), in southeastern corner of Kansas.
Prosopis julifloro glonduloso (Torr.) Cook (honey mesquite), in southern Kansas.
Pteleo trifoliota L. (hoptree), in eastern Kansas.
Rhamnus caroliniono Walt. (yellow buckthorn), in eastern Kansas.
Rhus copallino L. (dwarf sumac), in eastern Kansas.
Rhus glabra L. (smooth sumac) in the eastern two-thirds of Kansas.
Solix missouriensis Bebb (Missouri river willow), in northeastern Kansas.
Stophyleo trifolia L. (bladdernut), in the eastern half of Kansas.

Descriptions of the common cultivated fruit trees, as apples, pears, apricots, plums and cherries, are also omitted.

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* Contribution No. 267 of the Department of Botany and Plant Pathology, Kansas State Agricultural College.

Names.

In scientific study the names which are given to plants and animals are known as their scientific names. They consist of two parts; the first, which designates the genus, corresponds to the surname of people, and the second, which designates the species, corresponds to the given name of people. For example, *Acer saccharinum* refers to the genus *Acer,* and to the species *saccharinum.* Scientific names are always in Latin, as that is most satisfactory the world over. Common names vary greatly in different localities, and among different people even in the same locality, and thus are frequently misleading or indefinite.

For convenience in arranging the knowledge on the subject and to indicate the relationship between the different plants, species are grouped into genera (singular, genus), genera into families, families into orders, orders into classes, and classes into phyla. The names of families regularly end in "aceæ" and of orders in "-ales." Three phyla are represented among the trees of the state: the Cycadophyta, by *Ginkgo;* the Strobilophyta by the pines, spruces, cedars and arborvitæs; and the Anthophyta—which contain almost all of the trees in the state.

Identification.

In separating different plants from one another, reference may be had to the detailed description or to drawings or to photographs, looking them over until one comes to one that seems to fit. However, this laborious method is usually replaced by special helps known as keys. A key is merely a simple means of following through sets of contrasting characters until one comes to single groups. In practice a key is made by making a study of the things to be included, deciding on some point which will separate some of these from others, then taking each separate group in turn and picking out characteristics which will separate these into two groups, those which have and those which have not the character in question. This is continued as long as there are two or more plants in a group. In following through a key, one starts with the number 1's, reading the characteristics of each group, then looking at the plant to find which character fits. Making the decision leaves the other group entirely out of consideration, and the user proceeds to the numbers under the "1" selected, viz., the number 2's, again selecting the one which fits, and so on until the name of a single plant is found. Great care should be exercised in keeping track of the place in the key and not jumping into an excluded part of the key. When the name of the plant is reached, it should be checked by reading over the description on the page indicated and looking at the picture if one is given. If this agrees, then the plant has been run through the key correctly. If there are great discrepancies one should start over, and if possible discover the error.

The keys in this work include the trees found native in Kansas, together with a number that are fairly commonly planted, but are not native to the state or even to the United States. They are considered in their winter (that is for most their leafless) condition, and in their summer condition. There are also included a few common native woody plants which are shrubs in this state. The absence of a page reference indicates, however, that they are not described in this bulletin.

Description in Winter.

In winter the most important part of a tree to study is the twig; that is, the growth of last year. On the twig one will find buds frequently at the tip (terminal bud), but more along the side at nodes (lateral buds). The internodes often have spots or lines which are known as lenticels, which are sometimes characteristic. Either immediately beneath or a very short distance beneath the bud a scar is to be expected. This is the scar left by the base of the leaf when the leaf dropped off. The various shapes and sizes may be quite characteristic. In the leaf scar there are other scars made where the vascular bundles of the leaf have been severed. These are known as the bundle scars, and their number, position and arrangement are valuable points in identification. At the edge or corners of the leaf scar there may be in some cases additional scars, known as the stipule scars. The leaf falling off very seldom leaves a membrane over the leaf scar. This membrane is likely to be present until spring, when with the swelling of the twig it also is cast off, leaving the real leaf scar behind.

The twigs may be characteristically colored, may be smooth, waxy or hairy, or occasionally may have an odor that is characteristic, and thus present a great many points for characterization. The pith or central part of the twig may vary in size and cross section, in color, and in a few cases may be broken up in plates (chambered pith), or may be continuous, or excavated (hollow).

The buds may grow into more or less stunted, sharp-pointed branches, known as thorns. In other cases the epidermis or outer covering of the stem may grow into pointed structures known as prickles. Other characteristics are: coverings of the buds themselves, consisting of scales or hairs; the shape, size, color; the apex; the direction in which the bud runs (whether divergent or close to the twig). The bud immediately above the leaf scar is the axillary bud; additional buds may occur on either side (accessory) or the additional buds may be farther up the stem (superposed). In a few cases, as, for instance, the elms, some of the buds will grow into twigs bearing flowers; and others, twigs bearing leaves. Such buds are quite different in appearance. In other cases the so-called flower buds and leaf buds look alike.

The twigs which are more than a year old are called branchlets or branches, depending upon the age. Usually the branches are not very serviceable for identification, but occasionally prominent corky ridges make them very serviceable or even necessary.

The bark on the trunk of trees is sometimes a very characteristic point, but does not lend itself to expression in words. Photographs are the only means of showing important differences.

Description in Summer.

In summer the twigs may sometimes still be used, especially if they are of a striking color or hairiness, or have corky ridges, but usually one is dependent upon the leaves, and less frequently the flowers. The fruit is quite characteristic. With regard to the leaves, the most important things to note include the arrangement, *i.e.*, there are one (alternate), two (opposite), or three (whorled) leaves at a node. Whether the leaf is simple (that is without any lobes extending down to the midrib) or compound is also important. When compound leaves look like many simple leaves, the absence of a bud in the

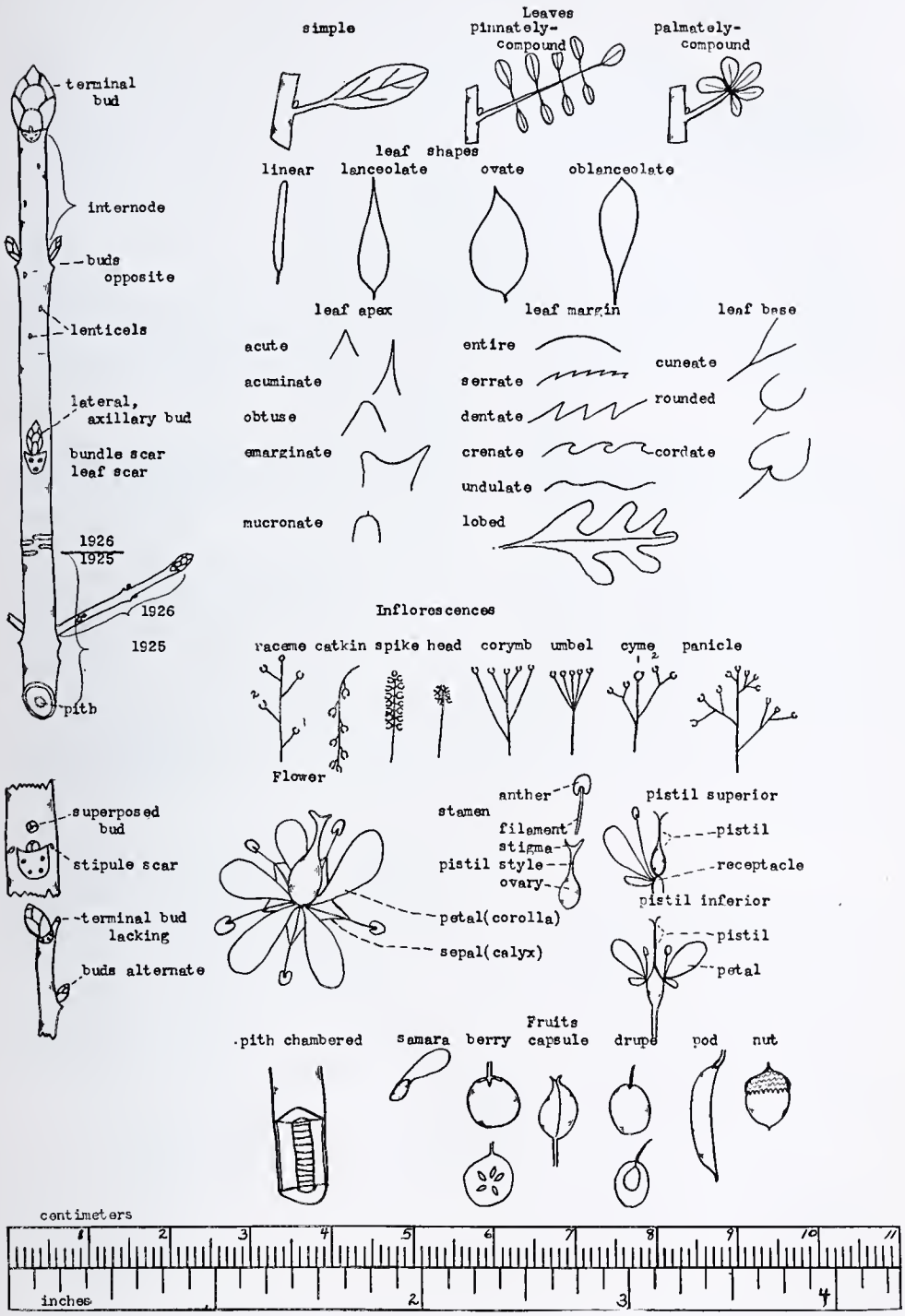

FIG. 117.—Sketches illustrating the terms most frequently used in descriptions of trees.

axil of the leaflets will settle this point. The margin, apex, base, the texture and the covering are other points which may be considered.

Flowers.

As a rule the flowers of trees are small and rather inconspicuous, often, in fact, not noted by the average person at all. In many cases they are not perfect, and often the corolla is lacking. The arrangement of flowers in clusters and the parts of a complete flower are shown in an accompanying diagram.

Fruit.

In some cases the fruit is very typical of genera and even of species within the genus. The samaras of the maple and ash, the acorns of the oak or the legumes of the various leguminous trees are ordinary cases. Fruits, however, are not infrequently absent, so that they cannot be depended upon for identification.

Acknowledgments.

For much of the material and a majority of the illustrations presented herein the author is indebted to Prof. Chas. H. Otis, author of "Michigan Trees," and the University of Michigan, the owner of the copyright. In all cases the data have been scrutinized carefully and changed wherever necessary to fit the trees as they occur in this state. The most frequent changes are in the diminution of the height to which the trees grow and changes in leaf dimensions. The distribution in Kansas is based on the work of A. S. Hitchcock and associates, supplemented with all available data since. Acknowledgment is likewise due to Prof. R. J. Pool, of the University of Nebraska, for illustrations of certain trees. Also to Prof. L. E. Melchers acknowledgment is made for his interest in and continuous support of this project. The standard "common names" recommended by the Forest Service (in Sudworth's "Check List") are employed.

Flora of Kansas.

To aid in the preparation of an up-to-date flora of the state, specimens may be sent for identification to Department of Botany, Kansas State Agricultural College, Manhattan, Kansas. Such specimens should be numbered, if more than one is sent, and a duplicate with a corresponding number retained by the sender.

Authentic lists from the various parts of the state are very welcome, but even more desirable are sets of dried specimens from each county. Such specimens will be added to the herbarium.

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KEY TO GENERA OF KANSAS TREES IN SUMMER.

NOTE.—Continuation of the key or description of the plant will be found on the page indicated. In the absence of page citations, neither descriptions nor illustrations are given in this publication.

PAGE

1 Leaves simple.
  2 Leaves needles or scales, conifers.
    3 Leaves needles.
      4 Needles in groups of two or more on short spurs (dwarf branches) sheathed with scales.....*Pinus*, 167
      4 Needles single, not in scale-sheathed clusters.
        5 Leaves alternate.
          6 Twigs very slender; if lateral, usually deciduous; needles deciduous; cone scales peltate; bark cinnamon-brown..*Taxodium distichum* (Bald Cypress)
          6 Twigs ordinary, lateral twigs persistent; evergreen; cone scales imbricated.
            7 Leaves 4-sided, on raised bases from which they disarticulate, leaving the branchlet rough.....*Picea*, 167
            7 Leaves separating directly from the twig or branch.
              8 Leaves definitely petioled and decurrent in ridges on the twigs; usually a few serrations near the tip; cone small (less than 2 cm). *Tsuga canadensis* (Hemlock)
              8 Leaves very slightly, if at all, decurrent.
                9 Leaves on horizontal branches spread out in one plane; leaf scars not at all raised; buds resinous; cones upright....*Abies concolor* (White Fir)
                9 Leaves on all branches projecting in nearly all directions; leaf scars slightly raised; buds not resinous; cones drooping, with 3-pronged scales. *Pseudotsuga*, 194
        5 Leaves opposite or whorled.
          6 Foliage sprays fanlike; fruit a cone not fleshy.....*Thuja*, 167
          6 Foliage sprays not fanlike; fruit fleshy.....*Juniperus*, 196
    3 Leaves scales.
      4 Foliage sprays fanlike; fruit a cone not blue.....*Thuja*, 167
      4 Foliage sprays not fanlike; fruit fleshy, blue.....*Juniperus*, 196
  2 Leaves ordinary, sometimes narrow, but not needles.
    3 Leaves more than one at a node.
      4 Leaves three or more at a node, *i. e.*, whorled.
        5 Trees with relatively large leaves (over 15 cm. long) ovate, cordate.....*Catalpa*, 171
        5 Shrubs with sunken buds; leaves smaller, lanceolate; flowers in globose heads.....*Cephalanthus occidentalis* (Buttonbush)
      4 Leaves two at a node, *i. e.*, opposite (exceptionally a node with three leaves may be found or in rapidly growing shoots the one leaf of a pair may be higher than the other).
        5 Leaves very large (often exceeding 30 cm. long).....*Paulownia*, 260
        5 Leaves moderate or very small.
          6 Leaves lobed.....*Acer*, 174
          6 Leaves not lobed.

Key to Genera in Summer—*Continued.*

PAGE

7 Bundle scars three, leaves entire or wavy-toothed ..... *Cornus*, 356
7 Bundle scars three or more, leaves serrate or serrulate ..... *Viburnum*, 177
7 Bundle scar one.
8 Buds superposed ..... *Forestiera*, 258
8 Buds solitary ..... *Evonymus atropurpureus* (Wahoo)
3 Leaves only one at a node, *i. e.*, alternate.
4 Plant armed with spines, prickles or stunted thornlike branches.
5 Twigs and leaves more or less covered with silvery peltate scales ..... *Elæagnus*, 296
5 Twigs without scurf.
6 Sap milky.
7 Leaves narrow (under 25 mm.); fruit small ..... *Bumelia*, 246
7 Leaves wider; fruit large (over 6 cm.) multiple; thorns decreasing in size towards the tip of the stem ..... *Toxylon*, 222
6 Sap not milky.
7 Nectar glands present at base of leaf or on petiole ..... *Prunus*, 172
7 Nectar glands absent.
8 Bud scales fleshy; fruit small (under 20 mm.), core bony; thorns usually smooth and somewhat curved ..... *Cratægus* (Thornapples), 270
8 Bud scales thin; fruit large, core papery ..... *Malus*, 171
4 Plants unarmed.
5 Leaves without lobes and with entire margins.
6 Leaves and twigs more or less covered with silvery scales ..... *Elæagnus*, 296
6 Without silvery scales.
7 Leaves extremely small or very narrow ..... *Tamarix* spp. (Tamarisk)
7 Leaves otherwise.
8 Leaves about as broad as long; old twigs blackish, zigzag ..... *Cercis*, 282
8 Leaves decidedly longer than broad.
9 Mucilaginous and aromatic; twigs green ..... *Sassafras*, 204
9 Not very mucilaginous.
10 Leaves 2-ranked at least on spreading branches.
11 Leaves pinnately veined.
12 Buds with scales; pith may be chambered ..... *Diospyros*, 248
12 Buds naked or very brown-hairy; leaves broadest above the middle ..... *Asimina*, 202
11 Leaves palmately veined ..... *Cercis*, 282
10 Leaves with more than 2 ranks.
11 Pith 5-angled ..... *Quercus imbricaria*, 346
11 Pith cylindrical.
12 Pith chambered ..... *Diospyros*, 248
12 Pith not chambered.

KEY TO GENERA IN SUMMER—*Continued.*

PAGE

13 Leaves whitened beneath ..... *Cornus alternifolia* (Alternate-leaved Dogwood)
13 Leaves not whitened beneath (unless by tomentum).
14 With abundant gummy sap when cut; pith relatively large, brown ..... *Cotinus americanus* (Smoke Tree)
14 Milky sap; pith moderate, whitish ..... *Toxylon*, 222
14 Sap neither milky nor gummy ..... *Pyrus communis* (Pear)
5 Leaves lobed or margins not entire, but toothed.
6 Leaves fan-shaped, veins coming from the base ..... *Ginkgo biloba*, 180
6 Leaves otherwise and net-veined.
7 Stipules or stipule scars encircling the twig.
8 Leaves truncate or emarginate at apex ..... *Liriodendron*, 200
8 Leaves pointed at apex ..... *Platanus*, 294
7 Stipules not encircling the twig.
8 Buds with a single scale in front ..... *Salix*, 169
8 Buds naked or with several scales.
9 Mucilaginous and aromatic; twigs green ..... *Sassafras*, 204
9 Not very mucilaginous, if at all.
10 Leaves 2-ranked. at least on spreading branches.
11 Leaves palmately veined.
12 Sap milky ..... *Morus*, 169
12 Sap neither milky nor flowing freely.
13 Twigs very slender; pith often chambered ..... *Celtis*, 168
13 Twigs moderate; pith continuous ..... *Tilia*, 168
11 Leaves pinnately veined.
12 Buds naked ..... *Rhamnus caroliniana* (Yellow Buckthorn)
12 Buds scaly.
13 Bud scales several, 2-ranked ..... *Ulmus*, 168
13 Bud scales in more than 2 ranks.
14 End bud present.
15 Buds elongated; pith somewhat 5-angled; fruit berrylike ..... *Amelanchier*, 266
15 Buds short; pith 3 angled; fruit dry ..... *Betula*, 175
14 End bud always absent; twigs slender.
15 Bud scales striate (marked with fine lines).
16 Bark rough; fruit hoplike ..... *Ostrya*, 332
16 Bark cherrylike or white or papery ..... *Betula*, 175
15 Bud scales not striate; bark smooth, fluted ..... *Carpinus caroliniana* Walt. (Blue Beech)

Key to Genera in Summer—*Continued.*

PAGE

10 Leaves in more than 2 ranks.
  11 Pith distinctly 5-angled.
    12 Leaves palmately lobed.....*Liquidambar styraciflua* (Sweet Gum)
    12 Lobes, if present, pinnate.
      13 Buds often gummy; lowest scale in front.....*Populus*, 170
      13 Buds with lowest scale at the side.....*Quercus*, 175
  11 Pith not distinctly 5-angled, or if so bud stalked.
    12 Leaves with nectar glands at base or on the petiole.
      13 Twigs green or red; leaves drooping.....*Prunus* (*Amygdalus*) *persica* (Peach)
      13 Twigs duller (shades of brown or black).....*Prunus*, 172
    12 Leaves without nectar glands.
      13 Pith chambered.....*Diospyros*, 248
      13 Pith continuous.
        14 Leaves broadest above the middle.
          15 Twigs slender; fruit less than 6 mm. in diameter.....*Ilex decidua* (Deciduous Holly)
          15 Twigs ordinary; fruit more than 6 mm. in diameter.....*Crataegus*, 270
        14 Leaves broadest at or below the middle.
          15 Leaves whitened beneath.....*Cornus alternifolia* (Alternate leaved Dogwood)
          15 Leaves greenish, not whitened beneath (unless by tomentum).
            16 Twigs somewhat 3-angled; drupe small (less than 6 mm. in diameter).....*Ilex decidua* (Deciduous Holly)
            16 Twigs essentially or quite terete; fruit 8-75 mm. or more in diameter.
              17 Buds naked.....*Rhamnus caroliniana* (Yellow Buckthorn),
              17 Buds scaly.
                18 Without an end bud.....*Prunus*, 172
                18 With a terminal bud.
                  19 Leaves very finely serrate.....*Pyrus communis* (Pear)
                  19 Leaves toothed or lobed.
                    20 Buds distinctly long, not woolly.....*Amelanchier*, 266
                    20 Buds approximately globose.
                      21 Bud scales more or less fleshy.....*Cratægus*, 270
                      21 Bud scales not fleshy; more or less pubescent.....*Malus*, 171

Key to Genera in Summer—*Continued.*

PAGE

1 Leaves compound.
  2 Leaves opposite.
    3 Leaves palmately compound ..... *Æsculus*, 173
    3 Leaves pinnately compound.
      4 Leaves coarsely toothed or 3-5 lobed ..... *Acer negundo*, 306
      4 Leaves at most finely toothed.
        5 Leaflets 5 or more; fruit a samara with terminal wing ..... *Fraxinus*, 171
        5 Leaflets 3; twigs green or greenish; stipules present; fruit a bladdery pod ..... *Staphylea trifolia* (Bladdernut)
  2 Leaves alternate.
    3 Armed with thorns, spines or prickles.
      4 Armed structure modified branches which may be simple or more commonly branched ..... *Gleditsia*, 284
      4 Armed structures prickles or modified leaf parts.
        5 Leaves once-pinnate.
          6 Leaves punctate (with translucent dots); aromatic ..... *Zanthoxylum*, 226
          6 Leaves otherwise ..... *Robinia*, 173
        5 Leaves twice-pinnate ..... *Prosopis juliflora glandulosa* (Honey Mesquite)
    3 Unarmed.
      4 Leaves more than once compound, buds superposed.
        5 Leaflets large (3 cm. or more wide), ovate; twigs stout; large chocolate-brown pith ..... *Gymnocladus*, 286
        5 Leaflets medium (less than 1 cm. wide), elliptical; twigs moderate ..... *Gleditsia*, 284
      4 Leaves but once compound.
        5 Leaves apparently or really palmate.
          6 Sap milky or resinous.
            7 A liana (woody climber); poisonous ..... *Rhus toxicodendron radicans* (Poison Ivy)
            7 A shrub with aromatic odor when bruised ..... *Rhus crenata* (Aromatic Sumac)
          6 Sap not milky; leaves pale-dotted ..... *Ptelea trifoliata* (Hop Tree)
        5 Leaves distinctly pinnate.
          6 Pith chambered and buds normally superposed.
            7 Leaflets normally more than 9, terminal not larger than others; twigs pubescent; partitions light brown in color ..... *Juglans*, 174
            7 Leaflets usually less than 9, terminal often larger than others; twigs glabrous or pubescent or with yellowish waxy particles; partitions pale.. *Hicoria*, 174
          6 Pith continuous.
            7 Leaflets entire.

Key to Genera in Summer—*Concluded.*

PAGE

8 Petiole base hollow; terminal leaflet rather larger than the others ..... *Cladrastis*, 290
8 Petiole base not hollow, although it may cover the buds.
9 Twigs green or yellowish green; buds hidden ..... *Sophora*, 288
9 Twigs dark, glabrous or bristly; buds not conspicuous, if visible ..... *Robinia*, 173
9 Twigs pale (or dark); buds plainly evident, half round ..... *Sapindus*, 298
7 Margins of leaflets toothed or lobed.
8 Leaves with nectar glands on some of the teeth; twigs stout, with large pith; leaflets numerous ..... *Ailanthus*, 228
8 Without nectar glands.
9 Leaf scar nearly encircling the bud, shrubs ..... *Rhus glabra* (Smooth Sumac)
9 Leaf scar not encircling bud.
10 Rachis or axis of the leaf broadly winged, shrubs ..... *Rhus copallina* (Dwarf Sumac)
10 Rachis not winged between leaflets.
11 Leaf scars large, shield-shaped; buds superposed ..... *Hicoria*, 174
11 Leaf scars narrow or small.
12 Leaves even-pinnate; buds very small, superposed; twigs more or less polished and zigzag ..... *Gleditsia*, 284
12 Leaves odd-pinnate; buds rather large ..... *Sorbus* (Mountain Ashes)

KEY TO GENERA OF TREES IN KANSAS IN WINTER CONDITION.

NOTE.—Continuation of the key or description of the plant will be found on the page indicated. In the absence of page citations, neither descriptions nor illustrations are given in this publication.

PAGE

1 Foliage leaves persistent and usually evergreen.
  2 Foliage leaves needle-shaped, subulate, narrowly linear or scalelike; conifers.
    3 With dwarf branches (short spurs sheathed with scales, each bearing 2-5 foliage leaves) ..... *Pinus*, 167
    3 Without true dwarf branches.
      4 Leaf buds scaly, foliage leaves alternate or spirally whorled.
        5 Leaf scar not on a raised woody projection (sterigma), prominent, circular; leaves flat, more or less twisted into two ranks; cones upright. *Abies concolor* (White Fir)
        5 Leaf scar scarcely raised; leaves about 2 cm. long, projecting in nearly all directions; cones pendent, bracts longer than the scales, three-pointed. *Pseudotsuga*, 194
        5 Leaf scars on a sterigma, the base of the leaf remaining as a scale on the twig.
          6 Leaves flat, about 1 cm. long, mostly twisted into one plane, soft to the touch; cones quite small ..... *Tsuga canadensis* (Hemlock)
          6 Leaves more or less 4-sided, spreading in all directions, harsh to the touch ..... *Picea*, 167
      4 Leaf buds not scaly, naked.
        5 Foliage leaves small, scalelike, appressed, opposite, 4-ranked, closely covering the twigs which are decidedly flattened and fanlike; leaves of two shapes, the dorsal and ventral broader and less acute than the lateral ones; cone dry ..... *Thuja*, 167
        5 Foliage leaves of two types, scalelike and subulate, opposite or in threes; the scalelike leaves 4-ranked, appressed, causing the twigs to appear quadrangular, the subulate leaves spreading; one or both types of leaves on a plant; carpellate cone developing into a bluish-black, berrylike fruit, *Juniperus*, 196
  2 Foliage leaves with expanded blades, netted veins ..... *Quercus*, 176
1 Foliage leaves deciduous each year.
  2 Twigs without leaf scars or without apparent leaf scars.
    3 Pith central; a conifer whose twigs have numerous small scattered self-pruning scars, without apparent leaf scars, but with minute dry scale leaves, with featherlike dwarf branches, some usually remaining in winter ..... *Taxodium distichum* (Bald Cypress)
    3 Pith to one side of the branches; a flowering shrub or small tree, whose leaf bases are persistent; except on the very youngest part of the twigs, the axillary bud is more or less surrounded by small buds; twigs usually reddish ..... *Tamarix* spp. (Tamarisk)
  2 Twigs with evident leaf scars and lateral winter buds.
    3 Leaf scars opposite or whorled.
      4 Leaf scars normally whorled. (Whorled leaf scars rarely present on twigs whose leaf scars are normally opposite, such as box elder, whose twigs are coated with wax, and horse chestnut, whose twigs usually have large gummy terminal buds.)
        5 Twigs not waxy coated, stout; leaf scars large, hollowed out and conspicuously standing out from the side of the stem; pods long and slender. *Catalpa*, 171
        5 Twigs not waxy coated, usually slender; leaf scars moderate in size, not hollowed out or conspicuously standing out; fruit in globose heads; usually a shrub ..... *Cephalanthus occidentalis* (Buttonbush)

Key to Genera in Winter—*Continued.*

PAGE

4 Leaf scars opposite. (Occasionally, in very rapidly growing twigs, one leaf scar of the pair may be a short distance above the other.)
  5 Bundle scars 1, or several closely united in a curved line, appearing as 1, or in an ellipse or ring.
    6 Twigs very large (8-37 mm. in diameter), with hollow stem or large chambered pith, rapid growing; lenticels white, very conspicuous ..*Paulownia*, 260
    6 Twigs of ordinary size or small.
      7 Twigs very green, more or less 4-angled; pith diamond-shaped or rhomboidal; usually shrubby.....*Evonymus atropurpureus* (Wahoo)
      7 Twigs not green when ripe but gray, brown or red, sometimes 4-angled; pith cylindrical or nearly so.
        8 Twigs very thin or slender, leaf scars very small; twigs often with thorns and axillary buds often superposed.....*Forestiera*, 258
        8 Twigs ordinary.....*Fraxinus*, 171
  5 Bundle scars more than 1, but not in an ellipse or ring.
    6 Trees or shrubs with numerous bundle scars, sometimes in 3 areas, in a large heart-shaped leaf scar; pith rather large; terminal bud large, with numerous scales.....*Æsculus*, 173
    6 Bundle scars 3 or sometimes 5.
      7 With 4 distinct, separate stipule scars at each node; terminal bud normally self-pruned; twigs usually green....*Staphylea trifolia* (Bladdernut)
      7 Without stipule scars, although the leaf scars may meet.
        8 Terminal bud with two pairs of visible scales or fewer.
          9 Terminal bud with 2 long acuminate pubescent outer scales; line connecting the uppermost leaf scars notched.....*Cornus*, 356
          9 Terminal bud with one main pair of visible scales and a smaller pair at the base.....*Viburnum*, 177
        8 Terminal bud with several pairs of visible scales; bundle scars 3-5; twigs sometimes green.....*Acer*, 174
3 Leaf scars alternate.
  4 Twigs with distinct and complete stipular ridges, or rings at the leaf nodes.
    5 Leaf scar nearly surrounding the axillary bud; terminal bud self-pruned, buds more or less conical; wood with prominent medullary rays....*Platanus*, 294
    5 Leaf scar not surrounding the axillary bud; terminal bud not self-pruned; buds inclosed in the large connate stipules, rounded, not conical.
      6 Buds glabrous; twigs brown; pith with partitions; leaf scars oval or circular; bark spicy-aromatic.....*Liriodendron*, 200
      6 Buds downy, or if glabrous then the twigs red; pith with or without partitions; leaf scars U-shaped, oval, or circular; bark usually aromatic. *Magnolia* (Magnolias)
  4 Twigs without complete stipular rings.
    5 With thorns, prickles or spines; or with spurlike branches ending in thorns.
      6 With spines or prickles, normally a pair for each leaf scar.
        7 Buds ordinary in size, often red-rusty.....*Zanthoxylum*, 226
        7 Buds minute.

KEY TO GENERA IN WINTER—*Continued.*

PAGE

8 An irregular-shaped membrane covers 3-4 superposed buds until growth in spring; fruit a flat pod.....*Robinia*, 173
8 Buds above an elliptical or rounded leaf scar; fruit a rounded, curving pod, usually constricted between the seeds
Prosopis juliflora glandulosa (Honey Mesquite)

6 Twigs with typical lateral thorns, without terminal thorns.
7 Buds and young twigs conspicuously covered with brown or silvery scurf; older twigs green, or greenish brown, smooth; thorn at the side of the axil.....*Elæagnus*, 296
7 Buds and young twigs without conspicuous brown or silvery scurf.
8 With thorns beside the axillary buds; normally one for each leaf axil, becoming gradually smaller towards the tip of the twig, terminal bud absent.....*Toxylon*, 222
8 Thorns axillary, large, rarely branched except on the main trunk; usually with 2 lateral buds at the base, which may develop as twigs; numerous axils without thorns.....*Cratægus*, 270
8 Thorns commonly branched, situated above the axil of the leaf; leaf scar covering the 2 or more superposed axillary buds; twigs polished, often zigzag.....*Gleditsia*, 284
6 With thorns at the ends of branches or with spurlike branches ending in thorns, and in addition axillary thorns may be present.
7 Not with three distinct bundle scars.....*Bumelia*, 246
7 With 3 bundle scars.
8 Terminal bud self-pruned; twigs some shade of black, brown, or reddish.....*Prunus*, 173
8 Terminal bud present.
9 Buds conical, pungent, pubescent; twigs glabrous or nearly so, mostly olive-yellow; trees with erect growth, the branches not spreading as in most of the apples.....*Pyrus communis* (Pear)
9 Buds downy or pubescent; twigs usually pubescent, if glabrous then dark reddish-brown; trees with rounded crowns and spreading branches.
Malus, 172

5 Without thorns, prickles or spines, but some may have thorn-like stunted branches.
6 Leaf scars quite regularly 2-ranked; that is, with the third scar over the first.
7 Bundle scar 1; visible bud scales 2; twigs brown; pith sometimes with cavities.....*Diospyros*, 248
7 Bundle scars 3 or more.
8 Bundle scars more than 3, usually scattered.
9 Pith partitioned, solid; bundle scars 5-7; bark with fetid odor; terminal bud elongated, naked, silky; stipular scars none.....*Asimina*, 202
9 Pith not partitioned; bark not with a fetid odor.
10 Visible bud scales 1-3; twigs usually zigzag; bark mucilaginous, fibrous; buds rather fleshy, usually bright red; bud at end of twig very obliquely unsymmetrical, mucilaginous when chewed; medullary rays prominent when bark is removed; the winged fruiting panicle often persistent.....*Tilia*, 168
10 Visible bud scales more than 3; pith white, rather large.....*Morus*, 169

Key to Genera in Winter—*Continued.*

PAGE

8 Bundle scars 3.
9 Pith interruptedly partitioned, with (or without) cavities, small greenish-white ..... *Celtis*, 168
9 Pith solid.
10 Terminal bud present, long pointed; leaf scar narrow, contracted between the bundle scars ..... *Amelanchier*, 266
10 Terminal bud absent, or if present then the leaf scar oval or semicircular.
11 Twigs dark reddish-brown, speckled, often zigzag; buds reddish-violet, often superposed or clustered; leaf scars not oblique but below the lateral bud ..... *Cercis*, 282
11 Twigs dark brown or gray, not speckled; buds not superposed; leaf scars oblique.
12 Twigs gray ..... *Ulmus*, 169
12 Twigs usually reddish or brownish.
13 Twigs smooth, or very nearly so.
14 Twigs slender, very flexible, often with catkins in winter; lenticels rather conspicuous, spreading horizontally. A tree the bark of whose trunk and larger branches separates into white papery sheets ..... *Betula*, 175
14 Twigs ordinary, never with catkins; lenticels not spreading horizontally, bark never white ..... *Ulmus*, 169
13 Twigs not smooth, usually with at least a fine pubescence.
14 Leaf buds tiny (1.5 mm. long or less) ..... *Ulmus*, 169
14 All buds longer.
15 Bud scales striate, sharply pointed; catkins present in winter; a small tree with scaly bark; twigs short ..... *Ostrya*, 332
15 Bud scales not striate nor sharply pointed; catkins may be present in winter; a tree with reddish-brown, flaky bark. *Betula*, 175
15 Bud scales scarcely striate, buds ovoid, not sharply pointed; a tree with smooth, fluted bark, without catkins in winter. *Carpinus caroliniana* Walt. (Blue Beech)

6 Leaf scars not 2-ranked.
7 Pith to one side of the branches, the leaf base persistent. Twigs usually reddish; very slender towards the tip, where the axillary bud may or may not have an additional bud on either side. On the older parts of the twig the axillary bud is more or less surrounded by additional buds. *Tamarix* spp. (Tamarisk)
7 Pith at or very close to the center of the twig.
8 Bundle scars 2; pith brownish, spongy; bark, frequently of even the youngest twigs shredded; "dwarf branches" frequent ..... *Ginkgo*, 180
8 Without this combination of characters.

KEY TO GENERA IN WINTER—*Continued.*

PAGE

9 Pith partitioned, with air cavities.
  10 Twigs thick with large leaf scars and 3 prominent bundle scars; buds not triangular.....*Juglans*, 174
  10 Twigs ordinary; 2 visible scales in the triangular flattened buds; twigs zigzag at the tip.....*Diospyros*, 248
9 Pith not partitioned, continuous.
  10 With 2 or more obviously superposed axillary buds; all except 1 may be very small.
    11 Buds partly sunken, hardly projecting beyond the surface; terminal bud self-pruned or tips of branches withering.
      12 Leaf scar not surrounding the axillary buds; pith large, chocolate-colored; twigs robust, polished, mottled white and purplish-brown.....*Gymnocladus*, 286
      12 Leaf scar surrounding the axillary buds, quadrangular U-shaped; bark with pungent odor; pith white; usually a shrub. *Ptelea trifoliata* (Hop Tree)
      12 Leaf scar covering the axillary buds; pith small; twigs brown, polished, often zigzag.....*Gleditsia*, 284
    11 Buds not sunken in the epidermis.
      12 Pith cylindrical or nearly so.
        13 Leaf scar nearly or quite surrounding the hairy axillary buds; bundle scars 5-9; terminal bud self-pruned.....*Cladrastis*, 290
        13 Leaf scar not surrounding the axillary buds.
          14 Bundle scars 3; buds spherical, bark light gray; leaf scars heart-shaped; stipular scars none.....*Sapindus*, 298
          14 Bundle scar usually 1; buds rounded or somewhat pointed; stipular scars or minute stipules present. *Ilex decidua* (Deciduous Holly)
      12 Pith more or less 5-angled, yellowish or brownish; terminal bud large; bundle scars scattered; trees with tough twigs...*Hicoria*, 175
  10 Axillary buds single, or 2 or more side by side, not superposed.
    11 Shrubs with leaf scars nearly encircling the axillary buds, or much elevated; terminal bud self-pruned; bark resinous; pith large.
      12 Twigs stout, smooth, often somewhat fluted.....*Rhus glabra* (Smooth Sumac)
      12 Twigs stout, puberulent, terete.....*Rhus copallina* (Dwarf Sumac)
      12 Twigs slender; leaf scars much elevated, covering the small buds; flower buds often conspicuous in dense spikes. *Rhus crenata* (Aromatic Sumac)
    11 Leaf scars not nearly surrounding the axillary buds.
      12 Small scales representing leaves present at least near the tips of twigs; dead foliage sprays frequently present, the leaves flat needles; a conifer.....*Taxodium distichum* (Bald Cypress)
      12 No such scales ever present.
        13 Bundle scar 1, or if several then closely crowded and confluent, appearing as 1.
          14 Stipular scars and stipules present.
            15 Terminal bud absent; bud scales dark brown or black.....*Rhamnus* (Buckthorn)
            15 Terminal bud present; stipules minute, usually persistent.....*Ilex decidua* (Deciduous Holly)
          14 Stipular scars and stipules none.

Key to Genera in Winter—*Continued.*

PAGE

15 Young twigs and buds covered with brown or silvery scales; thorns normally present on branches, if not on twigs. *Elæagnus*, 296

15 Without scales or scurf on buds or twigs.

16 Terminal bud present; bark green, very spicy aromatic; internodes very unequal..... *Sassafras*, 204

16 Terminal bud absent, 2 visible scales in the triangular flattened bud; pith sometimes with cavities; twigs pubescent, zigzag at tip..... *Diospyros*, 248

13 Bundle scars more than 1.

14 Twigs green, often conspicuously swollen at the nodes; buds woolly; at first concealed by an articular membrane; leaf scar horseshoe-shape; fruit (resembling interrupted beads) often present..... *Sophora*, 288

14 Without this combination of characters.

15 Outer bud scale 1; twigs usually with brittle zones and hence very easily detached; stipular scars present; bundle scars 3. *Salix*, 170

15 Outer bud scales more than 1.

16 Pith more or less 5-angled.

17 Buds clustered at the tip of the twig; bundle scars numerous, scattered..... *Quercus*, 176

17 Buds not clustered at the tip.

18 Bundle scars numerous, usually scattered; lateral buds usually superposed..... *Hicoria*, 175

18 Bundle scars 3.

19 Bud scales, not very shiny; buds often gummy; no corky ridges..... *Populus*, 170

19 Bud scales very shiny; small branches and often twigs corky ridged. *Liquidambar styraciflua* (Sweet Gum)

16 Pith cylindrical or nearly so.

17 Pith very large, light brown, bark not resinous, ill-smelling; buds spherical or flattened at the apex, often clustered at the tip of the twig, brown and pubescent; bundle scars about 9 along the lower edge of the very large leaf scar; large trees..... *Ailanthus*, 228

17 Pith small, or if large and brown then the bark resinous.

18 Bark with a resinous or sticky milky sap; pith usually large, if rather small then the bark aromatic.

19 Liana (woody climber); poisonous..... *Rhus toxicodendron radicans* (Poison Ivy)

19 Shrub (rarely a small tree); without stipule scars; fruiting panicles plumose and frequently present; bark spicy-fragrant to smell..... *Cotinus americanus* (Smoke Tree)

19 Tree; with stipule scars; sap, although milky, usually not freely flowing..... *Morus*, 169

18 Bark not resinous.

19 Terminal bud absent.

KEY TO GENERA IN WINTER—*Concluded.*

PAGE

20 Stipules or stipular scars absent or indistinct.....*Prunus*, 173
20 Stipules or stipule scars present.....*Rhamnus* spp. (Buckthorn)
19 Terminal bud normally present.
20 Twigs green or yellowish green, glabrous; internodes very unequal; lateral buds minute; shrubs or small trees.....*Cornus alternifolia* (Blue Dogwood)
20 Twigs normally red above and green beneath, glabrous; bark very bitter; some axils with 2 or 3 hairy buds of nearly equal size; trees.....*Prunus* (*Amygdalus*) *persica* (Peach)
20 Twigs not green or red and green unless the plants are low shrubs, but gray, brown, black or reddish.
21 Bundle scars 5 or more in the broad U-shaped leaf scar; tips of the buds quite downy; small trees. *Sorbus* spp. (Mountain Ash)
21 Bundle scars 3.
22 Buds rounded at the apex; scales thick; twigs often zigzag; plant usually with some thorns, not glandular dotted.....*Crataegus* spp. (Thorn apples, Hawthorns)
22 Buds pointed; plants sometimes with thornlike stunted branches.
23 Buds glabrous or slightly pubescent; twigs usually glabrous and slender, some shade of black, brown, or reddish, often with 2 or 3 axillary buds; some with self-pruning scars. *Prunus*, 173
23 Buds downy or strongly pubescent, conical, pungent; twigs glabrous, mostly yellow-olive; trees with erect growth, the branches not spreading as in most of the apples. *Pyrus communis* (Pear)
23 Buds downy or strongly pubescent; twigs strongly pubescent, or if glabrous then dark reddish-brown; trees with rounded or spreading crowns.....*Malus*, 172
23 Buds and twigs very pubescent; terminal bud with long spreading parts; shrubs or small trees with globose berrylike drupes containing 3 stones. *Rhamnus caroliniana* (Yellow Buckthorn)

KEYS TO SPECIES.

Summer and Winter Key to the Species of *Pinus* (Pine).

PAGE

1 Fascicles containing 5 leaves.....*Pinus strobus* (White Pine), 182
1 Fascicles containing 3 (rarely 2 or 4) leaves.
  2 Needles under 13 cm. long; small leafy branches along trunk from adventitious buds.
    Pinus rigida (Pitch Pine)
  2 Needles over 15 cm. long; twigs stout; without adventitious buds.
    Pinus ponderosa (Western Yellow Pine), 190
1 Fascicles containing 2 (rarely 3) leaves.
  2 Leaves 10-15 cm. long, dark green; ovuliferous scale with a very small prickle.
    Pinus nigra (Austrian Pine, *Pinus laricio*), 186
  2 Leaves normally under 9 cm. in length.
    3 Leaves 6-9 cm. long, yellowish green; cones 7.5 to 12.5 cm. long, their scales tipped with very stout short spines; cones often remaining on the tree for many years.
      Pinus pungens (Table Mountain Pine)
    3 Leaves less than 7 cm. long.
      4 Leaves 3.5 to 7 cm. long.
        5 Twigs dull greenish-yellow or greenish-brown; cones 5 to 7.5 cm., short stalked.
          Pinus sylvestris (Scotch Pine), 188
        5 Twigs blackish; bushy shrub, dwarf branches densely clustered; cones essentially sessile.....*Pinus mugo mughus* (Swiss Mountain Pine)
      4 Leaves 1 to 2.5 cm. long; cones 2.5 to 5 cm. long, usually upwardly curved.
        Pinus banksiana (Jack Pine), 184

Summer and Winter Key to the Species of *Picea* (Spruce).

1 Branchlets glabrous.
  2 Odor of leaves fetid; cones scarcely 5 cm. long.
    Picea glauca (White Spruce, *Picea canadensis*)
  2 Odor of leaves balsamic; cones 7-18 cm. long.
    3 Leaves pointing forwards; branchlets generally pendulous; pistillate flowers bright purple.....*Picea abies* (Norway Spruce), 192
    3 Leaves radially spreading at nearly right angles, bluish-green; pistillate flowers green.
      4 Stiff horizontal branches.
        Picea pungens (Colorado Spruce, Colorado Blue Spruce, *Picea parryana*)
      4 Pendulous branches with bluish-white foliage. *Picea pungens kosteriana* (Blue Spruce)
1 Branchlets pubescent.
  2 Cones under 2.5 cm. long, scales entire or toothed; leaves projecting at right angles or nearly so.....*Picea mariana* (Black Spruce)
  2 Cones over 10 cm. long, scales toothed; leaves projecting forwards and on usually pendulous branches.....*Picea abies* (Norway Spruce), 192
  2 Cones about 5 cm. long, scales oblong or rhomboidal, normally toothed; leaves bluish-green, soft and flexible, mostly forwardly directed, and with a strong odor when bruised.
    Picea engelmanni (Engelmann Spruce)

Summer and Winter Key to the Species of *Thuja* (Arborvitæ, White Cedar).

1 Foliage shoots mostly horizontal; cone scales thin; seeds winged.
  Thuja occidentalis (American Arborvitæ)
1 Foliage shoots mostly vertical; cone scales thick; seeds wingless.
  Thuja orientalis (Chinese Arborvitæ), 198

KEYS TO SPECIES—*Continued.*

Summer Key to the Species of *Tilia.*

1 Leaves glabrate, except in the vein-axils beneath. PAGE
  2 Leaves green beneath.....*Tilia glabra* (Basswood), 206
  2 Leaves white beneath.....*Tilia cordata* (Small-leaved Linden)
1 Leaves pubescent, at least on the veins beneath.
  2 Leaves green beneath; fruit typically ribbed.
    Tilia platyphyllos and varieties (Large-leaved Lime)
  2 Leaves whitened beneath; fruit not ribbed.....*Tilia heterophylla* (White Basswood)

Winter Key to the Species of *Tilia.*

The different species of *Tilia* here enumerated are so essentially alike in winter that a key is of questionable utility. But one, *Tilia glabra,* is native to the state.

Summer Key to the Species of *Celtis* (Hackberry).

1 Leaves thin, not strongly reticulate-veined beneath; twigs little if any pubescent.
  2 Leaves toothed or pubescent; buds relatively larger (over 2.5 mm.); trunk roughened throughout; drupe 8-11 mm. in diameter.....*Celtis occidentalis,* 208
  2 Leaves entire (rarely a few teeth) and glabrous; buds smaller (under 2 mm.); trunk relatively smooth; drupe 6-8 mm. in diameter.....*Celtis lævigata,* 210
1 Leaves thick, leathery, strongly reticulate-veined beneath; twigs pubescent.
  2 Leaves entire, or with serrations above the middle; peduncles 10 mm. or less long.
    Celtis reticulata, 212
  2 Leaves serrate to well below the middle; peduncles 15-25 mm. long.....*Celtis rugulosa,* 212

Winter Key to the Species of *Celtis.*

1 Buds under 2 mm. long; trunk relatively smooth; drupes 6-8 mm. in diameter.
    Celtis lævigata, 210
1 Buds over 2 mm. in length; trunk rough.
  2 Twigs glabrous (or slightly pubescent); buds 2.5 to 4 mm. long; trunk roughened throughout; drupes 8-11 mm. in diameter.....*Celtis occidentalis,* 208
  2 Twigs pubescent; western.
    3 Buds less than twice as long as wide; corky ridges on trunk often 2.5 cm. high; drupes 8-13 mm. in diameter on peduncles 10 mm. or less long.....*Celtis reticulata,* 212
    3 Buds more than twice as long as wide; drupes about 8 mm. in diameter on peduncles 15-25 mm. long.....*Celtis rugulosa,* 212

Summer Key to the Species of *Ulmus* (Elm).

1 Leaves mostly once-serrate, small (4-7 cm. long).....*Ulmus pumila* (Chinese Elm), 220
1 Leaves doubly serrate.
  2 Twigs or small branches often warty or corky-winged.
    3 Flowers nearly sessile; corky wings yellowish-brown.....*Ulmus japonica,*
    3 Flowers slender-stalked.
      4 Buds glabrous; corky wings thin.....*Ulmus alata* (Winged Elm)
      4 Buds pubescent; twigs coarsely corky.....*Ulmus racemosa,* 218
  2 Twigs not corky-winged.
    3 Buds glabrous or nearly so.
      4 Flowers nearly sessile; fruit pubescent.
        5 Leaves broadly oval or ovate, 5-8 cm. long; fruit about 12 mm. broad, with a short closed notch.....*Ulmus glabra* (English Elm)
        5 Leaves obovate or elliptical, 7-10 cm. long; fruit about 18 mm. broad, with an open notch.....*Ulmus japonica,*
      4 Flowers on a pendulous stalk; fruit glabrous except for the cilate edge.
        Ulmus americana (American Elm), 216
    3 Buds pubescent, red-hairy; twigs gray, bristly.....*Ulmus fulva* (Slippery Elm), 214

KEYS TO SPECIES—*Continued.*

Winter Key to the Species of *Ulmus*.

PAGE

1 Leaf buds tiny (1.5 mm. long), globose, usually but 4 scales visible.
Ulmus pumila (Chinese Elm), 220
1 Leaf buds larger or with more visible scales.
2 Twigs gray, somewhat bristly; buds rusty-tomentose; inner bark very mucilaginous when chewed..... *Ulmus fulva* (Slippery Elm), 214
2 Twigs otherwise.
3 Buds blackish red.
4 With no corky ridges..... *Ulmus glabra* (English Elm)
4 Normally with some yellowish-brown corky ridges on the tree; buds about 4 mm. long..... *Ulmus japonica*,
3 Buds brown.
4 Buds not over 6 mm. long, pointed; twig moderate, never with corky outgrowths.
Ulmus americana (American Elm), 216
4 Outermost buds over 6 mm. long, very sharply pointed; twigs slender; at least the branches with corky ridges..... *Ulmus alata* (Winged Elm)
4 Outermost buds 6 mm. long, somewhat hairy; usually at least some corky-ridged branches on the tree..... *Ulmus racemosa* (Cork Elm), 218

Summer Key to the Species of *Morus* (Mulberry).

1 Buds spreading; scales dark-margined; leaves rough above.. *Morus rubra* (Red Mulberry), 224
1 Buds appressed, uniformly colored; leaves nearly smooth.
2 Leaves rather exceptionally lobed..... *Morus alba* (White Mulberry)
2 Leaves mostly lobed.
3 Not weeping..... *Morus alba tatarica* (Tatarian Mulberry)
3 Weeping..... *Morus alba pendula* (Weeping Mulberry)

Winter Key to the Species of *Morus*.

1 Buds triangular, short; introduced plants.
2 Bud scales uniformly colored..... *Morus alba* (White Mulberry)
2 Bud scales brown margined; twigs weeping... *Morus alba pendula* (Weeping Mulberry)
1 Buds longer (over 6 mm.), bud scales dark margined; native. *Morus rubra* (Red Mulberry), 224

Summer Key to the Species of *Salix* (Willows).

1 Twigs brilliant golden-yellow..... *Salix vitellina* (Yellow or Golden Willow)
1 Twigs not golden-yellow.
2 Leaves broad, veiny beneath..... *Salix missouriensis*.
2 Leaves narrow or elongated.
3 Leaves narrow, linear; native..... *Salix longifolia*, 230
3 Leaves lanceolate, more or less peach-leaf shape.
4 Branchlets upright, native trees; leaf petioles without glands.
5 Leaves conspicuously silvery-glaucous beneath; petioles 2-7 mm. long.
Salix longipes wardii (Ward's Willow)
5 Leaves green or pale beneath, at least when mature.
6 Leaves under 18 mm. broad; petioles broad and flat, 2-6 mm. long.
Salix nigra, 234
6 Leaves over 18 mm. broad; petioles slender and terete, 10-30 mm. long.
Salix amygdaloides, 232
4 Branchlets weeping, cultivated tree; leaf petioles glandular above.
Salix babylonica (Weeping Willow)

KEYS TO SPECIES—*Continued.*

Winter Key to the Species of *Salix*.

PAGE

1 Twigs brilliant golden-yellow.....*Salix vitellina* (Golden Willow)
1 Twigs yellowish or otherwise, but not golden yellow.
  2 Leaf scars but little curved, if at all.
    3 A shrub or a slender pole-like tree.....*Salix longifolia* (Sandbar Willow), 230
    3 Large open trees.....*Salix nigra* (Black Willow), 234
  2 Leaf scar U-shaped.
    3 Twigs glabrous.
      4 Buds of youngest growth tiny, pubescent; twigs exceedingly slender; tree with most branchlets drooping.....*Salix babylonica* (Weeping Willow)
      4 Buds of youngest growth larger, glabrous or nearly so; merely slender twigs; tree without conspicuously drooping branchlets.
        Salix amygdaloides (Peach-leaved Willow), 232
    3 Twigs pubescent.....*Salix missouriensis.*

Summer Key to the Species of *Populus*.

1 Buds plump, not resinous or gummy.
  2 Leaves white- or gray-woolly beneath; petioles little flattened.
    Populus alba (White Poplar), 236
  2 Leaves not woolly; petioles much flattened.....*Populus* spp. (Aspens)
1 Buds elongated, more or less gummy; petioles flattened.
  2 Leaves triangular or ovate, broad at base, with long tapering apex and small, close teeth.
    3 Teeth of leaves small and close, usually without marked incurved points, margins not ciliate; capsules nearly sessile.
      4 Trees rounded; suckers normally absent.....*Populus nigra* (Black Poplar)
      4 Trees narrow, tall, erect (narrowly pyramidal); suckers present.
        Populus nigra italica (Lombardy Poplar), 238
    3 Teeth prominent, with incurved callous points; margin of leaf usually sparingly ciliate; trees oblong.....*Populus canadensis* (*Populus* sp., hybrids, Carolina Poplar), 240
  2 Leaves ovate to triangular-ovate, or sometimes broader than long, with mostly large open crenate teeth that usually point upward; margins commonly finely ciliate, at least early in the season; large wide-spreading trees; buds viscid.
    3 Branchlets gray or reddish-brown; winter buds glabrous; capsules twice or less longer than pedicels.....*Populus balsamifera* (Cottonwood), 242
    3 Branchlets light yellow; buds usually pubescent; leaves mostly broader at base than long; fewer coarser teeth than the above; capsule 3-4 times longer than pedicels.
      Populus sargentii (Plains Cottonwood), 244

Winter Key to the Species of *Populus*.

1 Buds and twigs more or less conspicuously white downy, twigs green; self-pruning scars very prominent on the small twigs.....*Populus alba* (White Poplar), 236
1 Twigs glabrous or nearly so.
  2 Twigs very slender, long, with slender glabrous buds; trees of tall narrow growth with strongly erect branches, giving a spire-like appearance.
    Populus nigra italica (Lombardy Poplar), 238
  2 Without this combination of characters.
    3 Trees ovoid or open; buds at and near the tip of the stout twig very prominent, thick and divergent; nodes of small branches often very conspicuously swollen.
      4 Buds glabrous.....*Populus balsamifera* (Cottonwood), 242
      4 Buds minutely velvety.....*Populus sargentii* (Plains Cottonwood), 244
    3 Trees oblong, with ascending branches; buds though they may be prominent, slender, appressed, divergent, or somewhat outwardly curved; twigs and young branches moderately slender, not very conspicuously swollen at the nodes.
      Populus canadensis (*Populus* sp., Carolina Poplar), 240

KEYS TO SPECIES—*Continued.*

Summer Key to the Species of *Fraxinus* (Ash).

PAGE

1 Twigs (at least of vigorous shoots) square; calyx wanting or a mere disk-like ring. *Fraxinus quadrangulata* (Blue Ash), 256

1 Twigs terete; calyx small, persistent in fruit.
  2 Leaves whitened beneath; fruit somewhat stout, wing extending out from top of fruit; leaf scars concave at top.....*Fraxinus americana* (White Ash), 250
  2 Leaves just a lighter green beneath; fruit slender, the narrow wing continuing to or nearly to base; scar margin nearly or quite truncate.
    3 Twigs glabrous.....*Fraxinus lanceolata* (Green Ash), 254
    3 Twigs velvety.
      4 Lateral leaflets stalked.....*Fraxinus pennsylvanica* (Red Ash), 252
      4 Lateral leaflets sessile; western part of the state.....*Fraxinus campestris.*

Winter Key to the Species of *Fraxinus.*

1 Twigs 4-angled.....*Fraxinus quadrangulata* (Blue Ash), 256
1 Twigs not angled.
  2 Twigs pubescent, often velvety; buds rusty-tomentose.
    3 Eastern part of state.....*Fraxinus pennsylvanica* (Red Ash), 252
    3 Extreme western part of state.....*Fraxinus campestris.*
  2 Twigs smooth or nearly so; buds not tomentose.
    3 Upper margin of leaf scars deeply concave; wing of samara terminal. *Fraxinus americana* (White Ash), 250
    3 Upper margin of leaf scars not concave, but straight across or projecting upward; wing of samara decurrent on the sides of the slender body..*Fraxinus lanceolata* (Green Ash), 254

Summer Key to the Species of *Catalpa.*

1 Pods about 5 mm. in diameter; leaves mostly angled; twigs hairy; mature leaves glabrous; flowers yellow, with orange stripes and dark violet spots within, less than 2.5 cm. long. *Catalpa ovata.*

1 Pods about 8 mm. in diameter; seeds pointed; leaves rarely angled; twigs glabrous; flowers 5 cm. in diameter; flowers white with 2 yellow stripes and purplish-brown spots within.
  2 Tree.....*Catalpa catalpa* (Catalpa), 264
  2 Shrub, or usually grafted as a standard.....*Catalpa catalpa nana.*

1 Pods fully 10 mm. in diameter; seeds obliquely truncate; leaves often angled: flowers over 6 cm. in diameter, inconspicuously spotted.....*Catalpa speciosa* (Catalpa), 262

Winter Key to the Species of *Catalpa.*

1 Twigs slender; pods slender, about 5 mm. diameter.....*Catalpa ovata.*
1 Twigs stout; pods about 8 mm. diameter; seeds pointed.....*Catalpa catalpa,* 264
1 Twigs stout; pods more than 10 mm. in diameter; seeds truncate.....*Catalpa speciosa,* 262

Summer Key to the Species of *Malus* (Apples, Crabapples).

1 Under side of leaves soft pubescent or tomentose when mature.
  2 Lobes of calyx reflexed in anthesis; pedicels short (mostly under 25 mm.); leaves closely crenate-serrate.....*Malus malus* (Apple)
  2 Lobes of the calyx erect or spreading; pedicels often or mostly more than 25 mm. long; leaves notched or strongly toothed with intermediate serrations. *Malus ioensis* (Iowa Crab Apple), 268

1 Under side of leaves fully or nearly glabrous, at least not soft pubescent or tomentose; leaves rather coriaceous in texture.....*Malus coronarius* (Crab Apple)
(See Bailey for other cultivated kinds.)

KEYS TO SPECIES—*Continued.*

Winter Key to the Species of *Malus.*

PAGE

1 Buds blunt-ovoid; scales subobtuse.....*Malus malus* (Apple)
1 Buds conical-oblong; scales acute.
  2 Twigs glabrate.....*Malus coronarius* (Wild Crab Apple)
  2 Twigs persistently woolly.....*Malus ioensis* (Iowa Crab Apple), 268

Summer Key to the Species of *Prunus.*

1 With scar left by terminal bud.
  2 Buds round-ovoid, scarcely longer than thick.
    3 Leaves round-ovate, firm, glabrous; buds dark, with ciliate scales.
      Prunus armeniaca (Apricot)
    3 Leaves distinctly longer than broad.
      4 Buds puberulent, dark red.....*Prunus domestica* (Plum)
      4 Buds glabrous.
        5 Leaves small (2-6 cm. by 1-2 cm.); bud scales reddish brown, ciliate; calyx lobes ciliate, eglandular, mostly glabrous within.....*Prunus angustifolia*, 276
        5 Leaves larger (6-11 cm. by 2.5 to 4 cm.); calyx lobes glandular-margined, pubescent, at least towards the base within.
          6 Leaves rather thick, ovate to ovate-lanceolate, only slightly shining above, veins usually conspicuous beneath, margin rather coarsely and irregularly serrate.....*Prunus hortulana*, 274
          6 Leaves usually rather thin, oblong-lanceolate to oval, shiny above, veins not very conspicuous, the margin finely and evenly serrate.
            Prunus munsoniana (Wild Goose Plum)
  2 Buds ovoid-conical, distinctly elongated; leaves oval or obovate; calyx lobes entire or nearly so, pubescent at least within.
    3 Flowers 18-25 mm. broad; leaves normally glabrous, acuminate even when they first unfold; bark of older trunks scaly; fruit ripe August to October; stone oval.
      Prunus americana (Wild Plum), 272
    3 Flowers 15-18 mm. broad; leaves normally tomentose beneath, commonly somewhat obtuse when they first unfold; bark of older trunks furrowed; fruit ripe October-November; stone obovoid to nearly round..... *Prunus mexicana* (Mexican Plum)
1 With terminal bud present.
  2 Buds round-ovoid.
    3 Fruit hairy, breaking away without a stalk, succulent.
      Prunus (*Amygdalus*) *persica* (Peach)
    3 Fruit glabrous, with a stalk, stone smooth.
      4 Leaves whitish, revolute; twigs often red; shrubs.
        Prunus besseyi (Western Sand Cherry)
      4 Leaves green, not revolute, nearly as broad as long, glabrous; trees. *Prunus mahaleb.*
  2 Buds distinctly elongated.
    3 Flowers and fruit in umbels.
      4 Tree percurrent; leaves rather drooping.....*Prunus avium* (Sweet Cherry)
      4 Tree deliquescent; leaves spreading.....*Prunus cerasus* (Sour Cherry)
    3 Flowers and fruit in racemes.
      4 Leaves usually gradually acuminate, with incurved teeth; buds brown.
        Prunus serotina (Wild Black Cherry), 280
      4 Leaves with spreading teeth, relatively short...*Prunus virginiana* (Choke Cherry), 278

KEYS TO SPECIES—*Continued.*

Winter Key to the Species of *Prunus.*

PAGE

1 Terminal bud usually present; leaves conduplicate in vernation; stone of drupe usually globose, little or not at all flattened.
  2 Twigs green or red.....*Prunus* (*Amygdalus*) *persica* (Peach)
  2 Twigs brown or gray.
    3 Twigs more or less velvety.....*Prunus mahaleb* (Mahaleb Cherry)
    3 Twigs glabrous.
      4 Buds dull brown, ovoid, scales rough.....*Prunus virginiana* (Choke Cherry), 278
      4 Buds clear brown or glossy.
        5 Buds small (2 by 4 mm.), glossy, scales rather fleshy.
Prunus serotina (Wild Black Cherry), 280
        5 Buds large (3 by 5-7 mm.).
          6 Buds glossy, narrowly ovoid.....*Prunus avium* (Sweet Cherry)
          6 Buds duller or darker, round-ovoid.....*Prunus cerasus* (Sour Cherry)
1 Terminal bud self-pruned; leaves convolute in vernation; stone of the drupe compressed.
  2 Buds scarcely longer than thick; small tree; thorn-like, stunted branches.
Prunus angustifolia (Chickasaw Plum), 276
  2 Buds elongated.
    3 Buds broadly-ovoid.
      4 Buds dark, sharply pointed, scales ciliate; twigs reddish. *Prunus armeniaca* (Apricot)
      4 Buds light brown, puberulent.....*Prunus domestica* (Garden Plum)
    3 Buds narrowly-ovoid.
      4 Shrub or small tree with stunted thorn-like branches and thick black bark.
Prunus americana (Wild Plum), 272
      4 Small tree with spreading branches and thin bark.
Prunus hortulana (Wild Goose Plum), 274

Summer and Winter Key to the Species of *Robinia.*

1 Twigs with sticky glands.....*Robinia viscosa* (Clammy Locust)
1 Twigs without sticky glands.....*Robinia pseudoacacia* (Black Locust), 292

Summer Key to the Species of *Æsculus.*

1 Leaflets broadest above the middle; buds gummy. *Æsculus hippocastanum* (Horse-chestnut), 300
1 Leaflets broadest about the middle; buds not gummy.
  2 Tree; leaflets mostly 5; inner face of claw of petals nearly uniformly yellow.
Æsculus glabra (Ohio Buckeye), 302
  2 Shrub; leaflets mostly 7; inner face of claw becoming rust color in mature flowers.
Æsculus arguta (Western Buckeye), 304

Winter Key to the Species of *Æsculus.*

1 Winter buds gummy; bundle scars arranged in a curved line.
Æsculus hippocastanum (Horse-chestnut), 300
1 Winter buds not gummy; bundle scars arranged in 3 areas.
  2 Shrub-like small tree.....*Æsculus arguta* (Western Buckeye), 304
  2 Tree.....*Æsculus glabra* (Ohio Buckeye), 302

KEYS TO SPECIES—*Continued.*

Summer Key to the Species of *Acer*.

PAGE

1 Leaves compound; plants diœcious.....*Acer negundo* (Boxelder), 306
1 Leaves simple.
  2 Under surface of the leaves gray or white.
    3 Sinuses acute; flowers appearing long before the leaves.
      4 Not weeping.....*Acer saccharinum* (Soft or Silver Maple), 308
      4 Weeping; leaves laciniate.....*Acer saccharinum wieri* (Cut-leaved Maple)
    3 Sinuses rounded obtuse; flowers appearing with or after the leaves; buds not concealed beneath widened petiole bases.....*Acer saccharum* (Hard or Sugar Maple), 310
  2 Under surfaces of the leaves green.
    3 Buds ovoid, large (the terminal 5 mm. or more); wings of fruit spreading horizontally. *Acer platanoides* (Norway Maple), 314
    3 Buds conical, pointed, gray-pubescent, but concealed beneath the widened petiol bases. *Acer nigrum* (Black Maple), 312

Winter Key to the Species of *Acer*.

1 Leaf scars meeting and continuing upwards into a free appendage; twigs green or brown, with a whitish bloom; buds white-woolly; fruit often persistent on the tree until spring. *Acer negundo* (Boxelder), 306
1 Leaf scars not quite meeting; twigs without whitish bloom; buds not white-woolly; fruit not persistent on the tree in winter.
  2 Twigs bright red; buds reddish or greenish.....*Acer saccharinum* (Soft or Silver Maple), 308
  2 Twigs brownish or grayish; buds brownish, or blackish.
    3 Buds ovoid, rather blunt.....*Acer platanoides* (Norway Maple), 314
    3 Buds conical or pointed.
      4 Buds glabrous, or somewhat pubescent at the apex only; bark dark gray on the trunk. *Acer saccharum* (Sugar or Hard Maple), 310
      4 Buds hoary-pubescent; bark sometimes almost black on the trunk. *Acer nigrum* (Black Maple), 312

Summer and Winter Key to the Species of *Juglans*.

1 Leaf scars with a downy cross-line at top; leaf scars not notched at top; terminal bud elongated (12-18 mm.).....*Juglans cinerea* (Butternut), 316
1 Leaf scars without a downy ridge at top, notched at top; terminal bud short (about 8 mm.).
  2 Buds ashen-pubescent; pith partitions close together (18 to 1 cm.). *Juglans nigra* (Black Walnut), 318
  2 Buds glabrate; pith partitions 8 to 1 cm.....*Juglans regia* (English Walnut)

Summer Key to the Species of *Hicoria*.

1 Bud scales in pairs, sometimes developing into small leaves; lateral buds often stalked.
  2 Twigs and buds with yellow glands; nut scarcely elongated, very thin shelled, very bitter. Leaflets 7-9.....*Hicoria cordiformis* (Yellow-bud Hickory, or Bitternut Hickory), 322
  2 Twigs scarcely glandular; nut longer than thick, rather firm shelled, not bitter. Leaflets 11-17.....*Hicoria pecan* (Pecan), 320
1 Bud scales not in opposite pairs, but imbricated.
  2 Terminal bud large (12-25 mm. long); husk splitting freely to the base, nut angled, seed sweet; middle lobe of the staminate calyx narrow, often at least twice as long as the lateral ones.
    3 Bark shaggy, separating in long plates; foliage glabrous or puberulent; outer bud scales persistent, pointed.

KEYS TO SPECIES—*Continued.*

Summer Key to the Species of *Hicoria*—*Concluded.*

PAGE

4 Leaflets 3-5 (rarely 7); twigs gray or reddish; nut rounded at base, 12-21 mm. long.
Hicoria ovata (Shagbark Hickory), 324

4 Leaflets 7-9; twigs buff or orange; nut usually pointed at both ends, 25-37 mm. long.
Hicoria laciniosa (King Nut, Big Shagbark Hickory), 326

3 Bark not shaggy, close, foliage very pubescent and fragrant; outer bud scales falling.
Hicoria alba (Mockernut), 328

2 Terminal bud small (6-12 mm. long); husk thin, not splitting freely to the base, nut slightly or not angled; lobes of the staminate calyx mostly nearly equal.
Hicoria glabra (Pignut Hickory), 330

Winter Key to the Species of *Hicoria.*

1 Outer bud scales few, usually 2.
2 Terminal buds flattened.
3 Yellow, with waxy particles; kernel bitter... *Hicoria cordiformis* (Bitternut Hickory), 322
3 Pubescent, not waxy; kernel sweet..... *Hicoria pecan* (Pecan), 320
2 Terminal bud, broad, dome-shaped, greenish, these and the upper part of twig more or less waxy; kernel of nut sweet..... *Hicoria glabra* (Pignut Hickory), 330
1 Bud scales numerous.
2 Bark of tree exfoliating in strips, shaggy; twigs tending to be glabrous; buds glabrous or nearly so, the outer bud scales not deciduous in autumn.
3 Nut 2.5 cm. long or less, with rather thin shell. *Hicoria ovata* (Little Shellbark Hickory), 324
3 Nut 3-5 cm. long, thick shelled..... *Hicoria laciniosa* (Big Shellbark Hickory), 326
2 Bark close and rough, not exfoliating; nuts globular, brownish; twigs more or less pubescent; buds densely hairy, the outer bud scales deciduous in autumn.
Hicoria alba (Mockernut), 328

Summer Key to the Species of *Betula* (Birch).

1 Bark reddish or greenish-brown; fruiting aments tomentose.... *Betula nigra* (River Birch), 336
1 Bark white or whitish, not flaking; fruiting aments not tomentose; leaves small (2-6 cm.); weeping in most forms..... *Betula pendula* (Weeping Birch), 334

Winter Key to the Species of *Betula* (Birch).

1 Lateral buds very blunt, hairy, 4-5 mm. with long lower scales; bark reddish-brown.
Betula nigra, 336
1 Lateral buds acute, with short lower scale, 5-6 mm. long; bark white..... *Betula pendula*, 334

Summer Key to the Species of *Quercus* (Oak).

1 Leaves entire..... *Quercus imbricaria* (Shingle Oak), 346
1 Leaves variously lobed.
2 Leaves or their lobes bristle-tipped; acorns maturing in autumn of second year.
3 Leaves 3-5-lobed above the middle, obovate or spatulate in outline.
Quercus marilandica (Blackjack Oak), 344
3 Leaves pinnatifid or pinnately lobed.
4 Longest lobes of the leaves about equaling (never twice as long as) the breadth of the broadish middle portion of the leaf..... *Quercus maxima* (Red Oak), 338
4 Longest lobes of the leaf 2-6 times as long as the breadth of the narrow middle portion of the leaf.
5 Scales of the cup closely appressed; trunk vertical, with branches at nearly or quite horizontal..... *Quercus palustris* (Pin Oak), 340
5 Upper scales of the cup loosely imbricated; inner bark orange.
Quercus velutina (Black Oak), 342

KEYS TO SPECIES—*Continued.*

Summer Key to the Species of *Quercus* (Oak)—*Concluded.*

PAGE

2 Leaves or their lobes not bristle-tipped; acorns maturing in autumn of first year.
  3 Leaves pinnatifid or pinnately lobed.
    4 Mature leaves glabrous or nearly so beneath; cup shallow.
      5 Fruit peduncles long (longer than the petioles).....*Quercus robur* (English Oak)
      5 Fruit peduncles short (not nearly as long as the petioles). *Quercus alba* (White Oak), 348
    4 Mature leaves finely pubescent beneath; cup ⅓ to fully as long as the acorn.
      5 Upper scales of the cup not awned.....*Quercus stellata* (Post Oak), 350
      5 Upper scales of the cnp awned, forming a fringe around the acorn. Branchlets conspicuously corky-ridged, at least by their second year.
        Quercus macrocarpa (Bur Oak), 352
  3 Leaves crenate or dentate, not lobed (except slightly in *Q. bicolor*).
    4 Fruiting peduncle 2.5 to 6 cm. long, much exceeding the petioles.
        Quercus bicolor (Swamp White Oak)
    4 Fruit sessile or on very short peduncles.
      5 Leaves with 8-13 teeth on each margin, oblong, obovate or lanceolate; tree.
        Quercus muehlenbergii (Chinquapin or Chestnut Oak), 354
      5 Leaves with 3-7 teeth on each margin, oval or obovate; shrub or low tree.
        Quercus prinoides (Dwarf Chinquapin Oak)

Winter Key to the Species of *Quercus*.

1 Buds about as high as wide, rounded; terminal buds usually about 3 mm. long.
  2 Bud scales pubescent.
    3 Branches and often twigs more or less corky-ridged; twig glabrous or minutely pubescent at apex; acorns maturing in the autumn of first season.
        Quercus macrocarpa (Bur Oak), 352
    3 Branchlets not corky-ridged; twigs pubescent.....*Quercus stellata* (Post Oak), 350
  2 Bud scales glabrous; branchlets and twigs smooth and shining.
    3 Twigs red or light brown; scales of cup appressed; acorn nearly globose.
      4 Shrub or low tree.....*Quercus prinoides* (Dwarf Chinquapin Oak)
      4 Tall tree.....*Quercus muehlenbergii* (Chinquapin or Chestnut Oak), 354
    3 Twigs light gray; scales of cup tubercled; acorn oblong, about 2.5 cm. long.
        Quercus alba (White Oak), 348
1 Buds 1½ to 2 times as high as wide, pointed.
  2 Scales glabrous; bark of trunk smoothish or only slightly fissured, inner bark not bitter-tasting; nut inclosed only at the base by a shallow, saucer-shaped cup.
    3 Buds 5-6 mm. long; growth deliquescent; branches ascending; acorns ripening the second season.....*Quercus maxima* (Red Oak), 338
    3 Buds 3-4 mm. long; growth excurrent; branches horizontal and pendulous.
      4 Acorn with a flat saucer-shaped cup; lobed dead leaves usually present on tree.
        Quercus palustris (Pin Oak), 340
      4 Acorn with a deeper cup, rather top-shaped; willow-shaped dead leaves usually present on tree.....*Quercus imbricaria* (Shingle Oak), 346
  2 Bud scales more or less pubescent, or tomentose; bark of trunk deeply furrowed and roughish, inner bark bitter-tasting; nut inclosed for about one-half its length by a deep, cup-shaped or turbinate cup.
    3 Twigs pubescent; acorn globular 12 mm. long or less.
        Quercus marilandica (Blackjack Oak), 344
    3 Twigs glabrous; buds hoary-tomentose, obtuse at the apex, strongly angled; inner bark of trunk yellow; acorns maturing in autumn of second season; nut 12-18 mm. long, with bitter kernel; lobed dead leaves usually remaining on the tree.
        Quercus velutina (Black Oak), 342

KEYS TO SPECIES—*Concluded.*

Summer Key to the Species of *Viburnum.*

PAGE

1 Leaves palmately veined and often lobed; shrub..... *Viburnum opulus* (Snowball)
1 Leaves pinnately veined, not lobed.
  2 Buds, petioles, etc., very red-scurfy..... *Viburnum rufidulum*, 362
  2 Buds, petioles, etc., rather gray-brown, rather glabrate.
    3 Leaves small (about 4 by 6 cm.) scarcely taper-pointed; twigs often stiff and spreading. *Viburnum prunifolium*, 360
    3 Leaves larger (about 5 by 8 cm.), acuminate..... *Viburnum lentago*, 358

Winter Key to the Species of *Viburnum.*

1 Buds ovoid, globose, bright red, smooth, not appressed, shrub. *Viburnum opulus* (Snowball)
1 Buds oblong or flask-shaped, mostly appressed, scurfy.
  2 Buds very red-scurfy..... *Viburnum rufidulum*, 362
  2 Buds brown, becoming lead colored.
    3 Twigs often short, rigidly spreading; buds nearly or quite smooth. *Viburnum prunifolium*, 360
    3 Twigs mostly elongated and flexuous..... *Viburnum lentago*, 358

LIST OF THE NATIVE AND THE MORE IMPORTANT PLANTED TREES OF KANSAS.

Phylum Cycadophyta (Cycads).

GINKGOACEÆ.

Ginkgo biloba L.

Phylum Strobilophyta (Conifers).

PINACEÆ.

Pinus strobus L.
Pinus banksiana Lamb.
Pinus nigra Arnold.
Pinus sylvestris L.
Pinus ponderosa Laws.
Pinus mugo mughus Zenari. (Note).
Pinus pungens Michx. (Note).
Pinus rigida Mill. (Note).
Picea abies (L.) Karst.
Picea pungens Engelm. (Note).
Picea engelmanni Engelm. (Note.)
Pseudotsuga taxifolia Britt.
Juniperus virginiana L.
Thuja orientalis L.
Thuja occidentalis L. (Note).
Taxodium distichum Rich. (Note).
Abies concolor Lindl. & Gord. (Note).

Phylum Anthophyta (Flowering Plants).

MAGNOLIACEÆ.

Liriodendron tulipifera L.

ANONACEÆ.

Asimina triloba Dunal.

LAURACEÆ.

Sassafras sassafras (L.) Karst.

TILIACEÆ.

Tilia glabra Vent.
Tilia platyphyllos Scop. (Note).

ULMACEÆ.

Celtis occidentalis L.
Celtis lævigata Willd.
Celtis reticulata Torr.
Celtis rugulosa Rydb.
Ulmus fulva Michaux.
Ulmus americana L.
Ulmus racemosa Thomas.
Ulmus pumila L.
Ulmus japonica Sarg. (Note).
Ulmus alata Michx. (Note).
Ulmus glabra Huds. (Note).

MORACEÆ.

Toxylon pomiferum Raf.
Morus rubra L.
Morus alba L. (Note).

RUTACEÆ.

Zanthoxylum americanum Mill.
Zanthoxylum clava-herculis L. (Note).
Ptelea trifoliata L. (Note).

SIMARUBACEÆ.

Ailanthus altissima (Mill.) Swingle.

SALICACEÆ.

Salix longifolia Muehl.
Salix amygdaloides Anders.
Salix longipes wardii (Bebb) Schneider (Note).
Salix nigra Marsh.
Salix vitellina L. (Note).
Salix missouriensis Bebb (Note).
Populus alba L.
Populus nigra italica Du Roi.
Populus canadensis Moench.
Populus balsamifera L.
Populus sargentii Dode.

SAPOTACEÆ.

Bumelia lanuginosa (Michx.) Pers.

EBENACEÆ.

Diospyros virginiana L.

OLEACEÆ.

Fraxinus americana L.
Fraxinus pennsylvanica Marsh.
Fraxinus campestris Britton (Note).
Fraxinus lanceolata Borkh.
Fraxinus quadrangulata Michx.
Forestiera acuminata (Michx.) Poir.
Chionanthus virginica L. (Note).

SCROPHULARIACEÆ.

Paulownia tomentosa (Thumb.) Steud.

BIGNONIACEÆ.

Catalpa speciosa Warder.
Catalpa catalpa (L.) Karst.
Catalpa ovata Don. (Note).

PHYLUM ANTHOPHYTA (FLOWERING PLANTS)—CONCLUDED.

MALACEÆ.

Amelanchier canadensis (L.) Medic.
Malus ioensis (Wood) Britton.
Malus coronaria (L.) Mill. (Note).
Malus malus (L.) Britton. (Note).
Pyrus communis L. (Note).
Cratægus palmeri Sarg. (Note).
Cratægus viridis L. (Note).
Cratægus mollis (T. & G.) Scheele. (Note).
Cratægus coccinoides Ashe. (Note).
Cratægus tomentosa L. (Note).

PRUNACEÆ.

Prunus americana Marsh.
Prunus mexicana S. Wats. (Note).
Prunus hortulana Bailey.
Prunus angustifolia Marsh.
Prunus munsoniana Wight & Hedrick (Note).
Prunus orthosepala Koehne (Note).
Prunus mahaleb L. (Note).
Prunus armeniaca L. (Note).
Prunus avium L. (Note).
Prunus cerasus L. (Note).
Prunus domestica L. (Note).
Prunus persica Sieb. & Zucc. (Note).
Prunus virginiana L.
Prunus serotina Ehrh.

CASSIACEÆ.

Cercis canadensis L.
Gleditsia triacanthos L.
Gymnocladus dioica (L.) Koch.

FABACEÆ.

Sophora japonica L.
Cladrastis lutea (Michx. f.) Koch.
Robinia pseudoacacia L.
Robinia viscosa Vent. (Note).
Robinia hispida L. (Note).

HAMAMELIDACEÆ.

Liquidambar styraciflua L. (Note).

PLATANACEÆ.

Platanus occidentalis L.

ELÆAGNACEÆ.

Elæagnus angustifolia L.

SAPINDACEÆ.

Sapindus drummondii H. & A.
Koelreuteria paniculata Laxm. (Note).

ÆSCULACEÆ.

Æsculus hippocastanum L.
Æsculus glabra Willd.
Æsculus arguta Buckl.

ACERACEÆ.

Acer negundo L.
Acer saccharinum L.
Acer rubrum L. (Note).
Acer saccharum Marsh.
Acer nigrum Michx.
Acer platanoides L.
Acer ginnala Maxim. (Note).
Acer tataricum L. (Note).

JUGLANDACEÆ.

Juglans cinerea L.
Juglans nigra L.
Hicoria pecan (Marsh.) Britton.
Hicoria cordiformis (Wang.) Britton.
Hicoria ovata (Mill.) Britton.
Hicoria laciniosa (Michx. f.) Sarg.
Hicoria alba (L.) Britton.
Hicoria glabra (Mill.) Britton.

BETULACEÆ.

Ostrya virginiana (Mill.) Willd.
Carpinus caroliniana Walt. (Note).
Betula pendula Roth.
Betula nigra L.

FAGACEÆ.

Quercus maxima Ashe.
Quercus palustris Du Roi.
Quercus shumardii Buckley (Note).
Quercus velutina Lam.
Quercus marilandica Muench.
Quercus imbricaria Michx.
Quercus alba L.
Quercus stellata Wang.
Quercus macrocarpa Michx.
Quercus muehlenbergii Engelm.
Quercus prinoides Willd. (Note).

CORNACEÆ.

Cornus florida L.

RUBIACEÆ.

Cephalanthus occidentalis L. (Note).

CAPRIFOLIACEÆ.

Viburnum lentago L.
Virburnum prunifolium L.
Viburnum rufidulum Raf.

GINKGOACEÆ.

Ginkgo biloba L.

Ginkgo.

Habit. A slender tree in youth, with slender, upright branches, becoming broader with age and forming a symmetrical, pyramidal crown; probably up to 18 meters (55 ft.) high, with a trunk diameter of 60-120 cm.

Leaves. Clustered at the ends of short, spurlike shoots, or scattered alternately on the long terminal branches; simple; 5-13 cm. broad; more or less fan-shaped; usually bilobed and irregularly crenate at the upper extremity; thin and leathery; glabrous, pale yellow-green on both sides; petioles long, slender; turning a clear, golden yellow before falling in autumn.

Flowers. May, with the leaves; diœcious; the microsporangiate in short-stalked, pendulous catkins, 2.5 to 4 cm. long, yellow; the megasporangiate more or less erect on the shoot, long-stalked, consisting of 2 naked ovules, one of which usually aborts.

Fruit. Autumn; a more or less globose drupe, orange-yellow to green, about 2.5 cm. in diameter, consisting of an acrid, foul-smelling pulp inclosing a smooth, whitish, somewhat flattened, almond-flavored nut.

Twigs in Winter. Twigs moderate, rounded, buff or gray, with quickly shredding outer bark and "dwarf branches." Pith rather small, somewhat 3-sided, brownish, spongy. Buds solitary, moderate, sessile, round-ovoid or hemispherical, with about 3 exposed scales, usually developing into blunt spurs. Leaf scars alternate, crowded on the spurs but separated elsewhere, somewhat crescent shaped, low, moderately small; bundle scars 2; stipule scars lacking.

Bark and Wood. Bark of twigs gray-brown and smooth, becoming thick, ash-gray and somewhat roughened on the trunk, and more or less fissured in old age. Wood light, soft, weak, close-grained, yellow-white to light red-brown, with thin, lighter colored sapwood.

Distribution in the State. In cultivation in the eastern part.

Habitat. Good soil.

Remarks. A "living fossil," native of eastern Asia thought to be preserved only through cultivation until found recently in China.

FIG. 118.—*Ginkgo biloba.*

1. Winter twig, x ½.
2. Leaf, x ½.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

(From Otis: Michigan Trees.)

PINACEÆ.

Pinus strobus L.

Northern White Pine, White Pine.

Habit. In this state not expected to be over 20 meters (65 ft.) high, with a trunk diameter of 35 cm.; forming a wide, pyramidal crown.

Leaves. In clusters of five; 8-13 cm. long; slender, straight, needle-shaped, 3-sided, mucronate; pale blue-green. Persistent about 2 years.

Flowers. June in cones; monœcious; the microsporangiate oval, light brown, about 8 mm. long, surrounded by 6-8 involucral bracts; the megasporangiate cylindrical, about 6 mm. long, pinkish purple, long-stalked.

Fruit. Autumn of second season, falling during the winter and succeeding spring; pendent, short-stalked, narrow-cylindrical, often curved; greenish cones, 10-25 cm. long; scales rather loose, slightly thickened at the apex; seeds red-brown, 6 mm. long, with wings 2.5 cm. long.

Twigs in Winter. As in summer. Buds oblong-ovoid, sharp-pointed, yellowish brown, 6-12 mm. long.

Bark and Wood. Bark of twigs at first rusty-tomentose, later smooth and light-brown, finally thin, smooth greenish, becoming thick, dark gray on the trunk, shallowly fissured into broad, scaly ridges. Wood light, soft, weak, compact, straight-grained, easily worked; light brown, with thin, whitish sapwood.

Distribution in the State. Not native, but planted in various parts of the eastern part of the state.

Habitat. Prefers a light, fertile loam; sandy soils of granite origin.

Remarks. Although a most beautiful tree, its planting is discouraged, and interstate traffic in it largely prohibited, as it is subject to the white-pine blister rust.

FIG. 119.—*Pinus strobus.*

1. Cluster of leaves, x 1.
2. Cross sections of leaves, enlarged.
3. Cone slightly open, x 1.
4. Cone scale with seeds, enlarged.

(Original.)

PINACEÆ.

Pinus banksiana Lamb.

Jack Pine.

Habit. Usually a small tree 4-9 meters (13-30 ft) high, with a trunk diameter of 10-20 cm.; forming a crown varying from open and symmetrical to scrubby, stunted, and variously distorted.

Leaves. In clusters of two; about 2.5 cm. long; narrow-linear, with sharp-pointed apex; stout, curved or twisted, divergent from a short sheath; dark gray-green. Persistent 2-3 years.

Flowers. May-June in cones; monœcious; the microsporangiate in oblong clusters 12 mm. long, composed of many sessile, yellow anthers imbricated upon a central axis; the megasporangiate in subglobose clusters, composed of many carpellike, purple scales (subtended by small bracts) spirally arranged upon a central axis.

Fruit. Autumn of second or third season, but remaining closed for several years and persistent on the tree for 10-15 years; erect, usually incurved, oblong-conical, sessile cones, 4-5 cm. long; scales thickened at the apex; seeds triangular, nearly black, about 10 mm. long, with wings 8 mm. long.

Twigs in Winter. As in summer. Terminal bud about 6 mm. long, ovoid, rounded, pale brown; lateral buds smaller.

Bark and Wood. Bark of twigs yellow-green, becoming purple, finally dark red-brown and rough with the persistent bases of fallen leaves, becoming thin, dark red-brown on the trunk, with shallow, rounded ridges, rough-scaly on the surface. Wood light, soft, weak, close-grained, light brown, with thick, whitish sapwood.

Distribution in the State. Not native to the state, but freely planted.

Habitat. Sandy, sterile soil.

Remarks. Planted groves may spread naturally if conditions are not too unfavorable. A very useful windbreak. Two or rarely three sets of megasporangiate cones may be produced from a single winter bud.

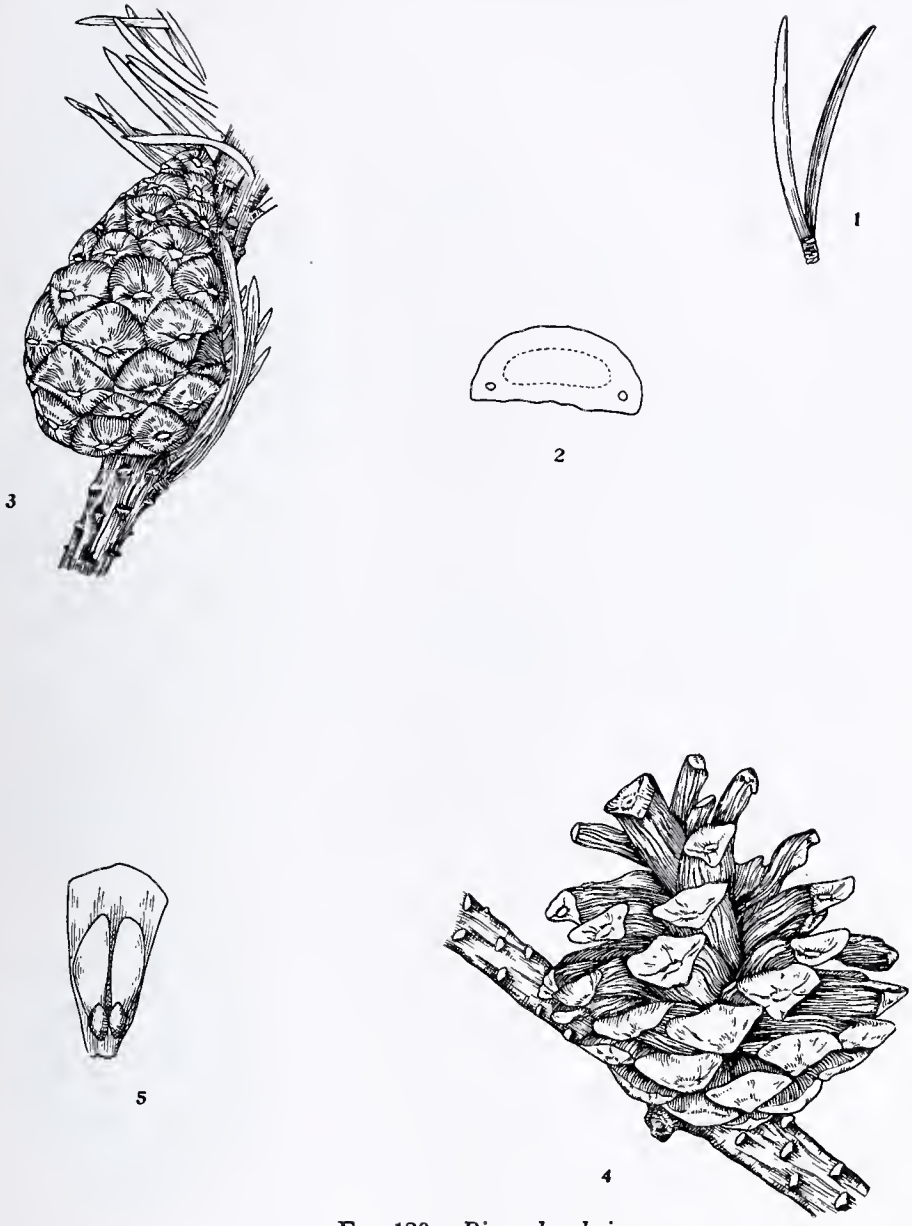

FIG. 120.—*Pinus banksiana.*

1. Cluster of leaves, x 1.
2. Cross-section of leaf, enlarged.
3. Branchlet with unopened cone, x 1.
4. Branchlet with opened cone, x 1.
5. Cone-scale with seeds, x 1.

(From Otis: Michigan Trees.)

PINACEÆ.

Pinus nigra Arnold (*Pinus laricio* Poir.).

Austrian Pine.

Habitat. A large tree 15-20 meters (50-65 ft.) high, with a trunk diameter up to 1 meter forming a massive, spreading crown of stiff, strong branches.

Leaves. In clusters of two; 7-18 cm. long; slender, rigid, sharp-pointed, curved towards the twig; deep green on both faces. Persistent 3-6 years.

Flowers. May-June in cones; monœcious; the microsporangiate cylindrical, subsessile, bright yellow, about 18 mm. long; the megasporangiate cylindrical, small, bright red, subsessile.

Fruit. Autumn of first season, opening two years after full size is attained and remaining on the tree several years; erect, sessile, long-ovoid cones 5-7 cm. long; scales smooth, shining, thickened at the apex and topped with a short spine in the center; seeds red-brown, 6 mm. long, with wings 18 mm. long.

Twigs in Winter. As in summer. Terminal bud oblong-conical, sharp-pointed, red-brown, resinous, about 12 mm. long, becoming whitish as it develops into a stout twig.

Bark and Wood. Bark brownish to olive-brown and smooth, becoming darker with age; thick, gray to nearly black on old trunks, and coarsely and deeply fissured. Wood light, strong, very resinous, red-brown, with thick, yellowish to reddish white sapwood.

Distribution in the State. Not native, but freely planted.

Habitat. Prefers good soil.

Remarks. A very desirable tree, especially the variety *Pinus nigra austriaca* Aschers & Graebn.

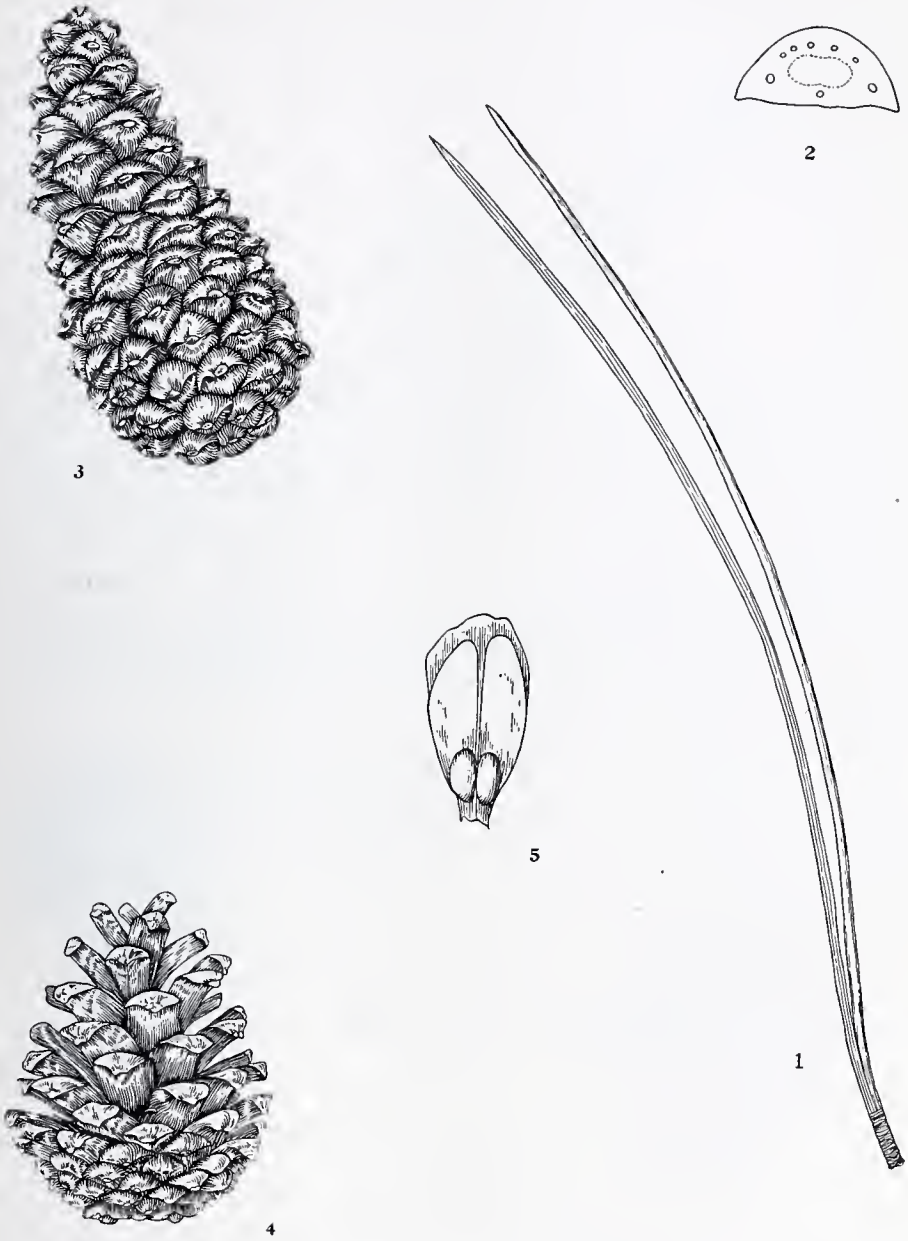

FIG. 121.—*Pinus nigra austriaca.*

1. Cluster of leaves, x 1.
2. Cross-section of leaf, enlarged.
3. Unopened cone, x 1.
4. Partly opened cone, x ½.
5. Cone-scale with seeds, x 1.

(From Otis: Michigan Trees.)

PINACEÆ.

Pinus sylvestris L.

Scotch Pine.

Habit. A large tree 15-20 meters (50-65 ft.) high, with a trunk diameter up to about 90 cm.; the side branches persist, forming a massive, wide-spreading crown.

Leaves. In clusters of two; 4-8 cm. long; stiff, more or less twisted, spreading slightly from a short sheath; bluish- or often glaucous-green. Persistent 3-4 years.

Flowers. May-June in cones; monœcious; the microsporangiate ovoid, short-stalked, yellowish, about 6 mm. long; the megasporangiate oblong, reddish, short-stalked, about 6 mm. long.

Fruit. Autumn of second season, falling as soon as ripe; pendent, stout-stalked, ovoid-conical cones 4 to 6.5 cm. long; scales dull gray-brown, thickened at the apex into 4-sided, recurved points; seeds red-brown, nearly 6 mm. long, with wings about 18 mm. long.

Twigs in Winter. As in summer. Buds oblong-ovoid, sharp-pointed, red-brown, resinous, about 6 mm. long, developing into slender twigs.

Bark and Wood. Bark reddish to orange-brown, becoming grayish; thick, dark orange-brown on old trunks and coarsely and deeply fissured. Wood light, stiff, straight-grained, strong, hard, resinous, red-brown, with thick, yellow to reddish white sapwood.

Distribution in the State. Not native, but very commonly planted.

Habitat. Various kinds of upland soil.

Remarks. A very desirable conifer for planting.

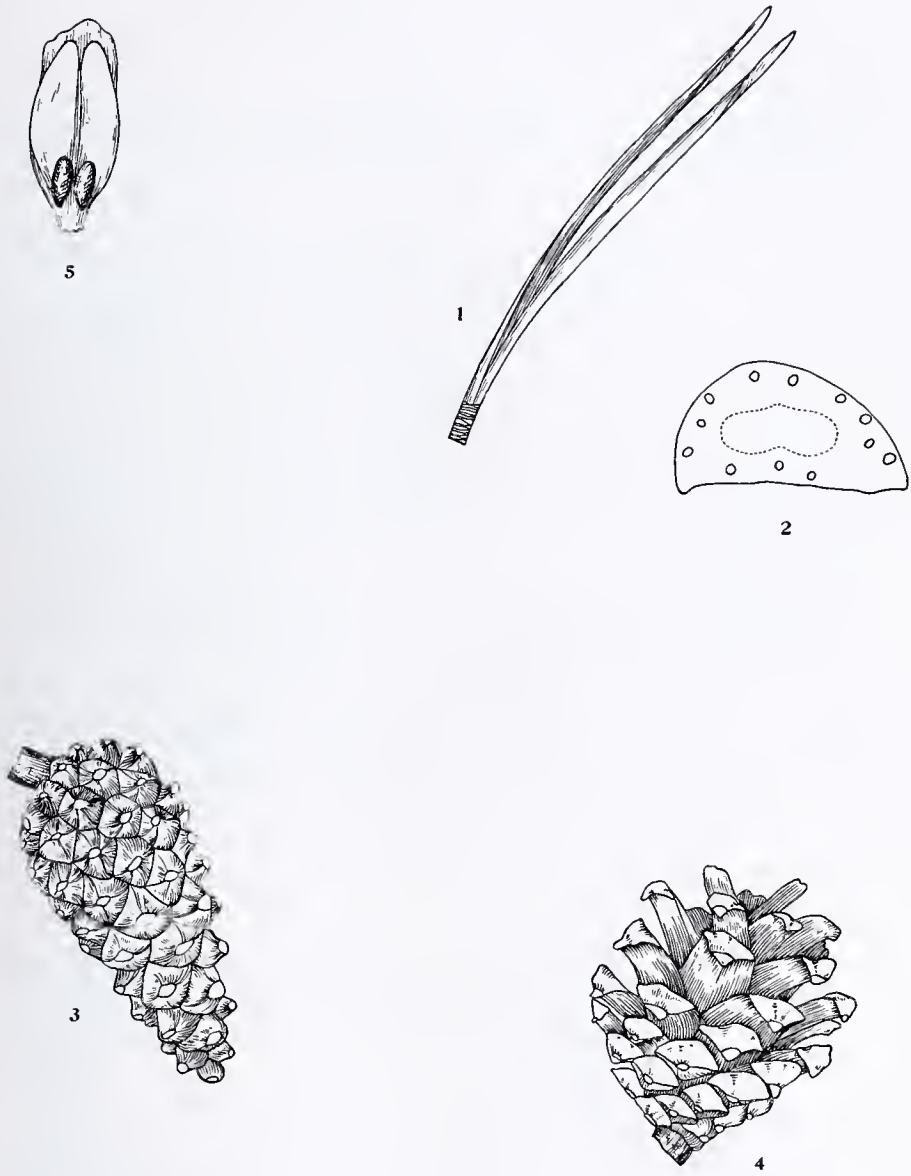

FIG. 122.—*Pinus sylvestris.*

1. Cluster of leaves, x 1.
2. Cross-section of leaf, enlarged.
3. Unopened cone, x 1.
4. Partly opened cone, x 1.
5. Cone-scale with seeds, x 1.

(From Otis: Michigan Trees.)

PINACEÆ.

Pinus ponderosa Laws.

Western Yellow Pine.

Habit. In the state a tree up to 15-21 meters (50-70 ft.) high, with a massive trunk; the short, thick, many-forked, often pendulous branches generally turned upwards at the ends, forming a broad round-topped moderate open or dense crown.

Leaves. Clustered in threes or infrequently in twos; tufted near the ends of stout twigs; stout, dark green, 12-25 cm. long; persistent usually two years.

Flowers. May-June in cones; microsporangiate in clusters at the base of the current shoots, yellow, 6-12 mm. long; megasporangiate cones clustered or in pairs, short-stalked, dark red with fleshy scales.

Fruit. August of the second year, shedding most of the seeds the month following; oval, horizontal or declining, with or without a short stalk, 7-13 cm. long, often clustered; bright green or purple when fully grown, becoming light reddish brown; scales narrow, thickened at the apex and armed with slender prickles, mostly falling soon after they open and shed their seeds, generally leaving the lower scales attached to the twig. Seeds ovate, acute, rounded, 6 mm. long, with a thin, often mottled shell, and surrounded by a membranous wing about 2.5 cm. long.

Twigs in Winter. As in summer. Terminal bud 12-18 mm. long; lateral buds about half as long, ovate, gradually narrowed and acute at the apex, light brown, developing into a stout twig.

Bark and Wood. Bark of twigs yellowish green, orange or later brownish, when crushed giving off an odor of orange; becoming in young trees blackish or reddish brown, narrowly furrowed; on old trees, broad shield-shaped, reddish plates 7-10 cm. thick and covered with small concave, reddish scales. Wood various shades of yellow, orange or reddish, with thin nearly white sapwood, quite hard, resinous, strong, fine-grained; largely manufactured into lumber, mine timbers, railway ties, and fuel.

Distribution in the State. Not naturally in the state, but frequently planted in many parts.

Habitat. Various types of upland soils in the sun.

Remarks. A very useful and ornamental tree, suitable for much of the state. A most important tree in the mountains to the westward of the state. Less frequently cultivated pines include:

Pinus mugo mughus Zenari (Mugho Pine), usually seen as a sprawling shrub, has the twigs densely clothed with needles, forming a round-tipped spray.

Pinus pungens Michx. (Table Mountain Pine), of the Appalachian mountains, has yellowish-green leaves, 2 in a fascicle, 6-9 cm. long; cones 7.5 to 12.5 cm. long, often remaining on the tree for many years, their scales tipped with very stout short spines.

Pinus rigida Mill. (Pitch Pine), of the extreme eastern United States, has leaves under 13 cm. in length, normally 3 in a fascicle; with small leafy branches along the trunk from adventitious buds.

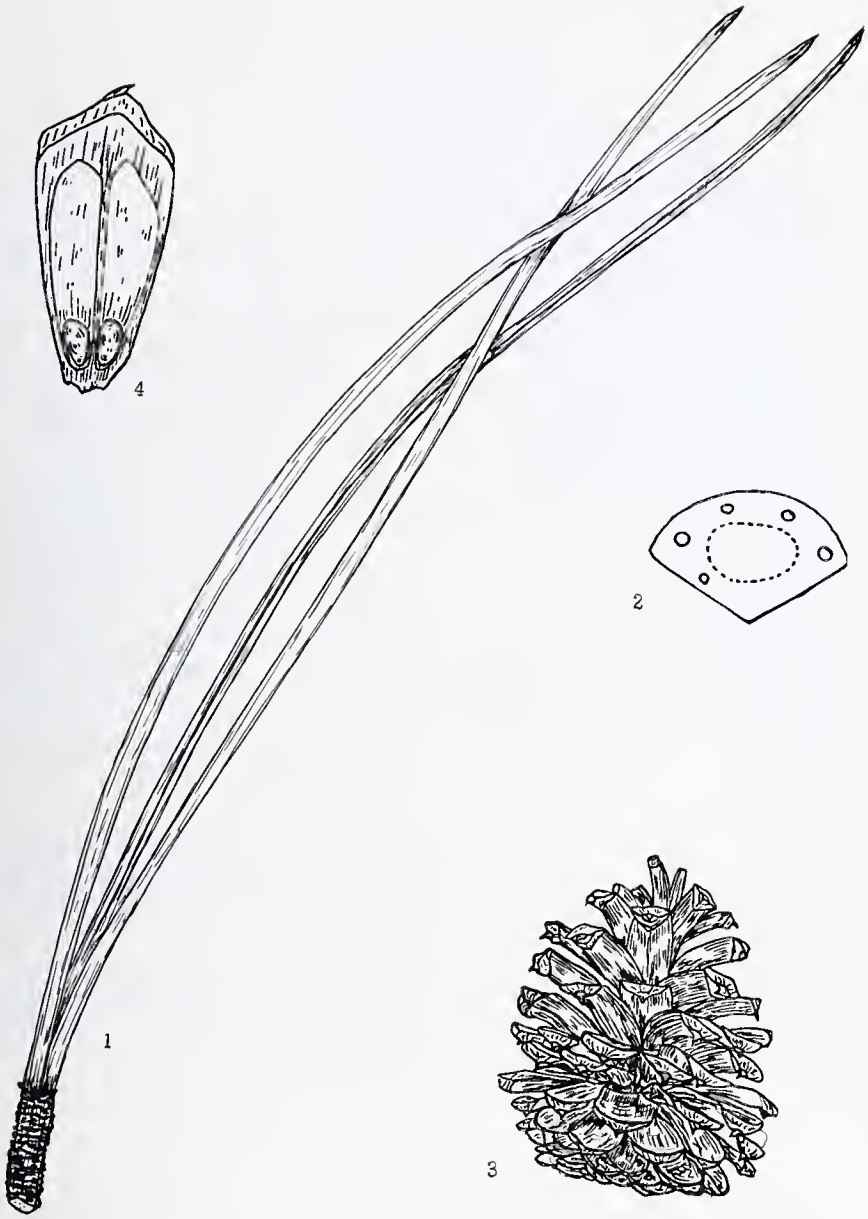

FIG. 123.—*Pinus ponderosa.*

1. Cluster of leaves, x 1.
2. Cross-section of leaf, enlarged.
3. Opened cone, x ⅓.
4. Cone-scale with seeds, x 1.

(From Pool: Nebraska Trees.)

PINACEÆ.

Picea abies (L.) Karst.

Norway Spruce.

Habit. A tree 15-21 meters (50-70 ft.) high, with a trunk diameter of up to 90 cm., forming a dense, conical, spire-topped crown of numerous, drooping branches which persist nearly to the ground.

Leaves. Spirally arranged along the twig; crowded; 18-25 mm. long; rigid, curved, acute; shining, dark green. Persistent 5-7 years.

Flowers. May in cones; monœcious; the microsporangiate ovoid to subglobose, long-stalked, reddish to yellowish, 18-25 mm. long; the megasporangiate cylindrical, sessile, erect, 4-5 cm. long.

Fruit. Autumn of first season; sessile, cylindrical cones 8-15 cm. long, pendent from the tips of the uppermost branches; sterile scales very short, toothed; seeds red-brown, rough, 3 mm. long, with long wings.

Twigs in Winter. As in summer. Buds ovoid, acute, red-brown, not resinous, about 9 mm. long.

Bark and Wood. Bark red- or orange-brown, smooth or corrugated; becoming thin and gray-brown on old trunks, slightly fissured, scaly. Wood light, strong, tough, elastic, soft, fine-grained, white, with thick, indistinguishable sapwood.

Distribution in the State. A native of Europe, planted.

Habitat. Good soils.

Remarks. Ornamental. Other cultivated spruces include:

Picea pungens Engelm. (Colorado Blue Spruce) is striking on account of the bluish color of the last season's growth; cones about 7 cm. long, pale chestnut-brown, scales rhomboidal, wavy toothed.

Picea engelmanni Engelm. (Engelmann Spruce), of the Rocky Mountain region, with leaves 13-26 mm. long, bluish-green, soft and flexible, mostly forwardly directed, strongly odoriferous when bruised; cones about 5 (4-8) cm. long, scales oblong or rhomboidal, normally toothed.

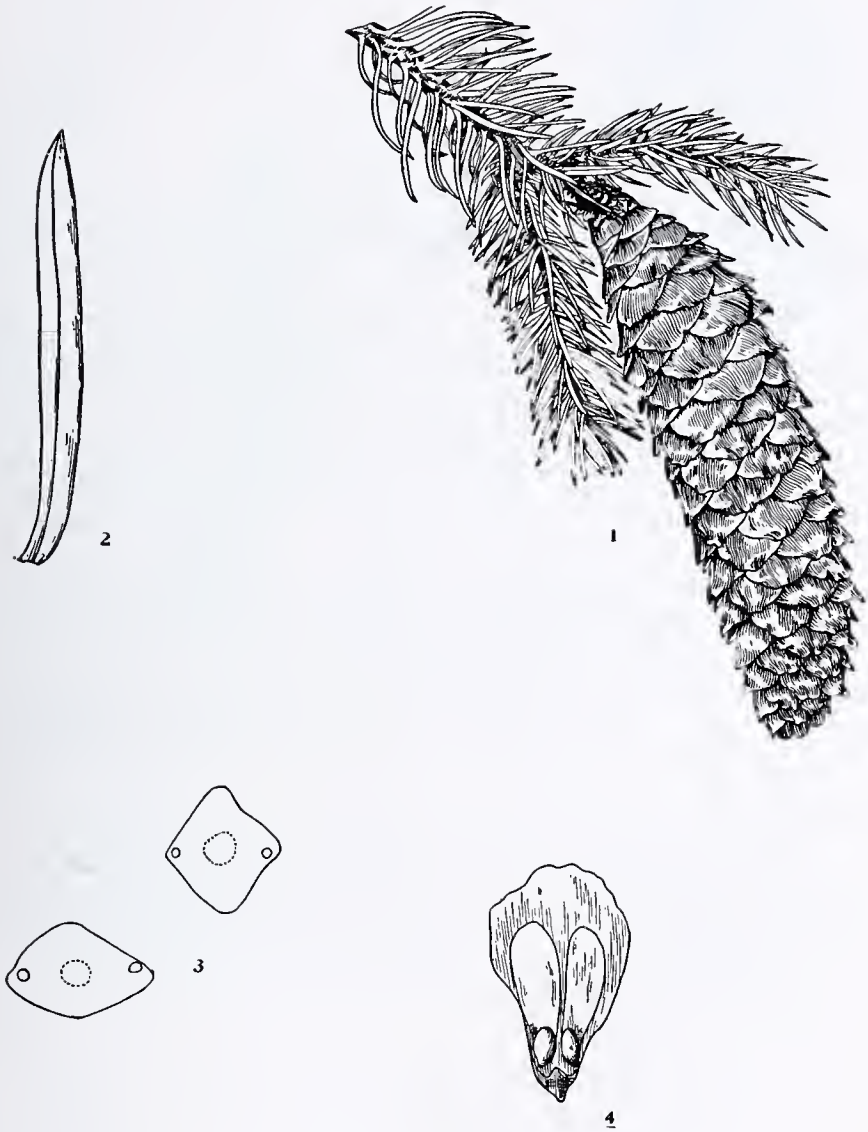

FIG. 124.—*Picea abies.*

1. Branchlet with partly opened cone, x ½.
2. Leaf, x 3.
3. Cross-sections of leaves, enlarged.
4. Cone-scale with seeds, x 1.

(From Otis: Michigan Trees.)

PINACEÆ.

Pseudotsuga taxifolia Britt.

Douglas Fir.

Habit. Tree reaching at least 18 meters (60 ft.) in this state, but three or more times higher than this in western America; with slender crowded horizontal branches from which droop leafy branchlets, forming an open pyramid.

Leaves. Spirally arranged around the twig; straight or a little incurved; 18-30 mm. long; flattened; slightly 2-ranked; grooved above, with white bands beneath on either side of a prominent midrib, dark yellow or bluish-green; obtuse; usually persistent 7 years, leaving a flat scar.

Flowers. May, in cones; monœcious; the microsporangiate axillary, 10-25 mm. long, orange-red, with numerous anthers; the megasporangiate terminal, reddish, 40-50 mm. long, of spirally arranged ovate scales shorter than the bracts.

Fruit. Autumn of first season; pendulous on a stout stem; ovate-oblong, 5-11 cm. long; scales thin, slightly concave, rounded, persistent; bracts narrow, at least 10 mm. longer than the scales, often bent outwards from the middle, 2-lobed at the apex with the rigid midrib produced into an awn. Seeds rounded, light reddish-brown and shining above, flat, pale with irregular white spots below, about 6 mm. long, 3-4 mm. wide; wings dark brown, a little longer than the seeds, broadest just below the middle, oblique and rounded at the apex.

Twigs in Winter. As in summer. Buds ovate or ovate-lanceolate, acute, reddish-brown; the terminal 6-10 mm. long, the lateral much smaller.

Bark and Wood. Bark of twigs pale orange and shining during first season, changing to bright reddish-brown and then to dark grayish-brown; smooth and thin, becoming on old trees thick and divided into oblong plates by broad ridges. Wood light red or yellow, with nearly white sapwood.

Distribution in the State. Native of western America, planted in eastern Kansas.

Habitat. Good soils.

Remarks. A very handsome tree, worthy of more extensive planting; an important lumber tree.

FIG. 125.—*Pseudotsuga taxifolia.*

1. Tip of twig, x ½.
2. Terminal bud, x 1.
3. Branch, showing three microsporangiate and one megasporangiate cone, x ½.
4. Single leaf, showing insertion.
5. Bract of a young megasporangiate cone, x ½.
6. Mature unopened megasporangiate cone, x 1.
7. Single scale and bract of a megasporangiate cone, enlarged.
8. Variation of bract, enlarged.
9. Top view of seed, x 1.
10. Side view of seed, x 1.

(Original.)

PINACEÆ.

Juniperus virginiana L.

Eastern Red Cedar, Red Juniper, Red Cedar.

Habit. A medium-sized tree 9-12 meters (30-40 ft.) high, with a trunk diameter of up to 50 cm.; forming an irregular, pyramidal or rounded crown.

Leaves. Opposite, of two kinds: (1) sessile, scalelike, closely appressed, overlapping, 4-ranked. ovate, acute, about 1.5 mm. long; (2) sessile, awl-shaped, loosely arranged, 6-12 mm. long. Persistent 5-6 years.

Flowers. May in cones; usually diœcious; minute; the microsporangiate oblong-ovoid, composed of 4-6 shieldlike scales, each bearing 4-5 yellow, globose pollen sacs; the megasporangiate ovoid, composed of about 3 pairs of fleshy, bluish scales, united at the base and bearing 2 ovules.

Fruit. Autumn of first or second season; subglobose, berrylike strobilus, about 6 mm. in diameter, dark blue and glaucous; flesh sweet and resinous; seeds 2-3.

Twigs in Winter. As in summer. Buds naked, minute.

Bark and Wood. Bark of twigs greenish to red-brown and smooth; thin, light red-brown on the trunk, exfoliating lengthwise into long, narrow, persistent strips, exposing the smooth, brown inner bark. Wood light, soft, close-grained, brittle, weak, durable, very fragrant, dull red, with thin, whitish sapwood.

Distribution in the State. Throughout or nearly so.

Habitat. Prefers loamy soil on sunny slopes; dry, rocky hills; also borders of lakes and streams; peaty swamps.

Remarks. The only native conifer at present in the state, very frequently planted as windbreaks, in hedges, and as an ornamental. One of the stages of an apple fungus grows upon it. Valuable for the wood also.

FIG. 126.—*Juniperus virginiana.*

1. Branchlet with awl-shaped leaves, x 1.
2. Tip of branchlet, showing awl-shaped leaves, enlarged.
3. Fruiting branchlet with scale-like leaves, x 1.
4. Tip of branchlet, showing scale-like leaves, enlarged.

(From Otis: Michigan Trees.)

PINACEÆ.

Thuja orientalis L.

Chinese Arborvitæ.

Habit. Shrub or small tree to 8 meters (27 ft.) high, with spreading and ascending branches and a rather ovoid crown; branchlets in vertical planes.

Leaves. Opposite, 4-ranked, scalelike, ovate, 3-6 mm. long, of main axes with free-spreading apex, of lateral twigs closely appressed; acute, bright green, with small gland on back, usually becoming brown in winter; strongly aromatic when crushed; persistent 1-2 years.

Flowers. April-May; usually monœcious; the microsporangiate cones minute, globose, yellow, composed of 4-6 stamens; the megasporangiate small, oblong, reddish, composed of 8-12 scales arranged oppositely on a short axis.

Fruit. Early autumn of the first season, but persistent usually through the winter; cones 12-25 mm. long, ovoid, about 6 fleshy greenish scales becoming brownish and woody; upper pair usually sterile; the seed thick, about 5 mm. long and wingless.

Twigs in Winter. As in summer, but the leaves frequently brown or somewhat purplish rather than green. Buds naked, minute.

Bark and Wood. Bark of twigs yellowish-green, becoming light red, finally light red to reddish-brown or orange-brown; thin, slightly furrowed or deciduous in ragged strips. Wood light, soft, pale yellowish-brown, with thin whitish sapwood.

Distribution in the State. A native of north China and Chosen, freely planted in the state as an ornamental.

Habitat. Good soil, not too dry.

Remarks. A most desirable conifer for specimen or hedge planting.

Thuja occidentalis L., native in northeastern America, is occasionally planted. It differs in having the branchlets in horizontal planes and the seeds are winged. It is known as the Northern White Cedar or the American Arborvitæ.

Among the conifers cultivated in the state mention might also be made of *Taxodium distichum* Rich. (Bald Cypress), with soft 2-ranked flat needles and fluted somewhat reddish trunk; in winter most of the ultimate shoots and their leaves deciduous.

Abies concolor Lindl. & Gord. (White Fir), with long (4 cm.) flat needles spread out in a single plane, at least on horizontal branches, coming away entirely, leaving the branchlet smooth; mature cones upright.

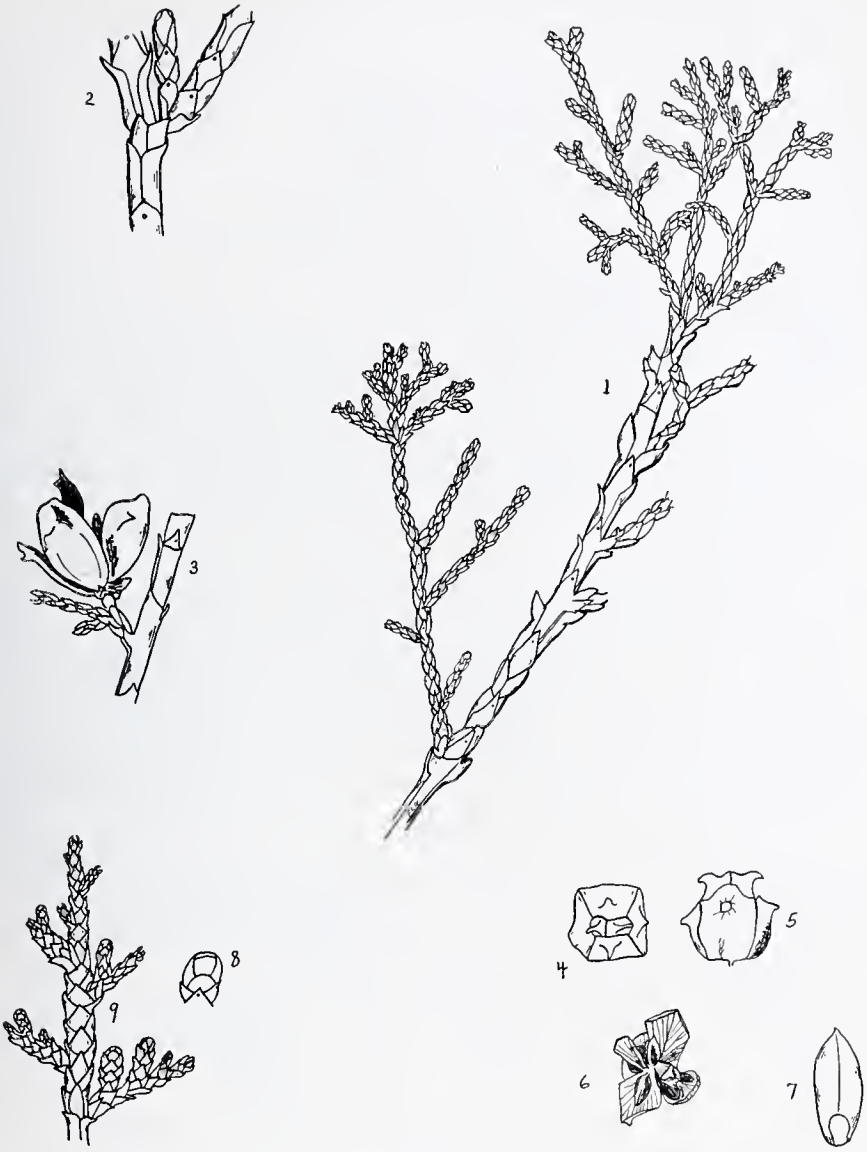

FIG. 127.—*Thuja orientalis.*

1. Spray, showing leaves, x ½.
2. Portion of a spray, enlarged.
3. Twig with an opened megasporangiate cone, x 1.
4. Megasporangiate cone from the top, x ½.
5. The same from the side, x ½.
6. Opened megasporangiate cone from above, showing wingless seeds, x ½.
7. A single seed, x 1½.
8. Microsporangiate cone, enlarged.
9. Spray with unopened microsporangiate cones, reduced.

(Original.)

MAGNOLIACEÆ.

Liriodendron tulipifera L.

Tulip Tree, Yellow Poplar.

Habit. In its native haunts, a large tree, but as planted, a sizable tree; columnar trunk with rather open branching.

Leaves. Alternate, simple, 13-15 cm. long and broad; 4-lobed; entire, emarginate; shining, dark green above, pale or glaucous beneath, turning clear yellow in autumn; petioles slender, angled, 13-15 cm. long.

Flowers. May-June, after the leaves; perfect; terminal; solitary on stout peduncles; tulip-shaped, greenish yellow, 4-5 cm. long; sepals 3, greenish, early deciduous; petals 6, in 2 rows, greenish-yellow with an orange spot at the base, early deciduous; stamens numerous, somewhat shorter than the petals; pistils numerous, clinging together about a central axis; ovary 1-celled.

Fruit. September-October; a narrow, light brown cone 6-8 cm. long, composed of numerous carpels; carpels long, flat, with a 1-2-seeded nutlet at the base, separating from the slender spindle at maturity.

Twigs in Winter. Moderate, waxy, smooth, shining, reddish becoming brownish, and at last gray. Pith rounded, pale, continuous, with firmer diaphragms at short intervals. Terminal bud 12-25 mm. long, rounded at the end, flattish, dark red, somewhat stalked, compressed, with 2 valvate scales, covered with a glaucous bloom; other buds smaller, rounded, sessile. Leaf scars rather large, round, low; bundle scars 10 or more in an irregular ellipse or scattered; stipule scars linear, encircling the twig.

Bark and Wood. Ashy gray, thin and scaly on young trunks, becoming thick, brownish, and deeply furrowed with age. Wood light, soft, brittle, weak, easily worked, light yellow or brown, with thin, cream-white sapwood.

Distribution in the State. Not native, but planted in the eastern third.

Habitat. Naturally in deep, moist, rich soil.

Remarks. At Manhattan maintains itself well, but shows no tendency to spread.

FIG. 128.—*Liriodendron tulipifera.*

1. Winter twig, x 1.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Fruit (opened and partly disseminated), x ½.

(From Otis: Michigan Trees.)

ANONACEÆ.

Asimina triloba Dunal.

Papaw.

Habit. A small tree, not commonly over 6 meters (20 ft.) high, nor 15 cm. in diameter.

Leaves. Alternate, simple, obovate-lanceolate, 20-30 cm. long by 10-15 cm., abruptly pointed at the apex, gradually and regularly narrowed to a long, wedge-shaped base; entire or somewhat wavy; as they open from the bud hairy above and rusty beneath, but shortly becoming smooth, light green above and paler beneath.

Flowers. With the leaves in April-May, perfect, solitary, axillary, often 5 cm. wide when fully open, on stout, hairy peduncles 2-4 cm. long, covered with scattered rusty-brown hairs; sepals 3, ovate, acuminate, pale green, hairy on the outer surface; petals 6, in 2 series, green becoming brown, the outer petals finally deep reddish-purple, veiny, very broad, turned back from about the middle, 2-3 times as long as the sepals; stamens many, densely packed in a globular mass in the center of the flower; pistils few.

Fruit. September-October, large, flattened-cylindric, fleshy, 5-13 cm. long, 2-4 cm. wide, greenish-yellow changing to brown or black, thin skin, thick, sweet flesh containing several large, flat, wrinkled brown seeds, about 2.5 by 1 cm.

Twigs in Winter. Light brown tinged with red and marked with shallow grooves more or less netted, inner bark tough and fibrous. Terminal bud clearly naked, larger, red hairy, the lateral obliquely superposed with the uppermost stalked and globose if a flower bud, or oblong and subsessile when a leaf bud. Pith roundish, white, continuous, but with firmer greenish diaphragms at intervals, becoming brownish and chambered in age. Leaf scars 2-ranked, half-round becoming broadly crescent- or horseshoe-shaped by rupture of the membranous top which at first covers the smaller buds; bundle scars 5-7, sometimes doubled; stipule scars lacking.

Bark and Wood. Dark brown with ashen blotches and small wartlike protuberances, divided by shallow irregular fissures into netlike plates. Wood light, soft, weak, coarse-grained, spongy, pale greenish-yellow, with thin sapwood; of no commercial importance.

Distribution in the State. The eastern third, west to Winfield on the south, to Manhattan in the Kansas valley, Valley Falls and northeast to state line.

Habitat. Usually found in bottom lands in deeply shaded woods.

Remarks. Fruit edible, although not relished by some people.

FIG. 129.—*Asimina triloba.*

1*a*. Twig in winter, x 1.
1*b*. The same from the side, x ½.
2. Single leaf, x ½.
3. Young twig, showing two flowers, x ½. (Redrawn from Sargent.)
4. Single flower from the outside, x ½.
5. Flower from which petals have been removed to show globular mass of stamens, x ½.
6. Fruit, part of which is sliced off to show seeds within, x ½.
7. Single seed sectioned to show the small embryo and runcinate endosperm, x 1.

(Original.)

LAURACEÆ.

Sassafras sassafras (L.) Karst.

(*S. variifolium* [Salisb.] Ktze., *S. officinale* Nees & Eberm.)

Sassafras.

Habit. Usually a large shrub, but often a small tree, with stout branches and a rather open crown.

Leaves. Alternate, simple, 8-15 cm. long, 5-10 cm. broad; oval to oblong or obovate; entire or 1-3-lobed with deep, broad sinuses and fingerlike lobes; thin; dull dark green above, paler beneath; petioles slender, about 2.5 cm. long.

Flowers. May, with the leaves; diœcious; greenish yellow; on slender pedicels, in loose, drooping, few-flowered racemes 5 cm. long; calyx deeply 6-lobed, yellow-green; corolla 0; stamens of staminate flower 9, in 3 rows; of pistillate flower 6, in 1 row; ovary 1-celled.

Fruit. September-October; an oblong-globose, shining, dark blue drupe about 9 mm. long, surrounded at the base by the scarlet calyx, borne on club-shaped, bright red pedicels.

Twigs in Winter. Smooth, shinning greenish-yellowish, spicy twigs becoming reddish-brown. Pith moderate, somewhat 5-sided, white, continuous. Terminal buds 8 mm. long, ovoid, acute; about 4 fleshy scales somewhat keeled, greenish, soft-pubescent, flower-bearing, aromatic; lateral buds much smaller. Leaf scars small, half-round or crescent-shaped, somewhat raised; bundle scar a transverse line more or less broken into 3; stipule scars lacking.

Bark and Wood. Thick, dark red-brown and deeply and irregularly fissured into firm, flat ridges on old trunks. Wood soft, weak, brittle, coarse-grained, very durable in the soil, aromatic, dull orange-brown, with thin, light yellow sapwood.

Distribution in the State. Valley of Spring river, Cherokee county.

Habitat. Woods or abandoned fields.

FIG. 130.—*Sassafras sassafras.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaves, x ½.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x ½.
7. Pistillate flower, enlarged.
8. Fruit, x ½.

(From Otis: Michigan Trees.)

TILIACEÆ.

Tilia glabra Vent.

(*Tilia americana* L.?)

Basswood.

Habit. A medium-sized tree normally in this state, but may reach large size, crown ovoid.

Leaves. Alternate, simple, 13-15 cm. long, 8-10 cm. broad; obliquely heart-shaped; coarsely serrate; thick and firm; glabrous except for axillary tufts of hairs; dull dark green above, paler beneath; petioles slender, 2.5-5 cm. long.

Flowers. June-July, after the leaves; perfect, regular; yellowish white, downy, fragrant; borne on slender pedicels in loose, drooping cymes, the peduncle attached for half its length to a narrow, oblong, yellowish bract; sepals 5, downy; petals 5, creamy white; stamens numerous, in 5 clusters; ovary 5-celled; stigma 5-lobed.

Fruit. October; globose, nutlike, woody, gray, tomentose, about the size of peas.

Twigs in Winter. Smooth, reddish-gray becoming darker, zigzag, with elongated internodes, terete. Pith round or squarish, moderate, continuous, pale. Terminal bud absent; lateral buds ovoid, acute, rather large, usually lopsided, smooth, dark or bright red, 6 mm. long. Leaf scars 2-ranked, somewhat elevated, half elliptical; bundle scars 3, or these compound and somewhat scattered; stipule scars unequal.

Bark and Wood. Dark gray and smooth on young stems; on old trunks thick, deeply furrowed into broad, scaly ridges. Wood light, soft, close-grained, tough, light red-brown, with thick sapwood of nearly the same color.

Distribution in the State. Eastern third (west to Cowley, Riley and Republic counties).

Habitat. Lowland woods along streams.

Remarks. An excellent shade tree for planting.

Tilia platyphyllos Scop., a European species with leaves pubescent beneath and yellow winter buds, is planted at Manhattan.

FIG. 131.—*Tilia glabra.*

1. Winter twig, x 1.
2. Leaf, x ½.
3. Cyme of flowers, with its bract, x ½.
4. Flower, with two petals, petaloid scales and stamens removed, enlarged.
5. Stamen, enlarged.
6. Fruit, x ½.

(From Otis: Michigan Trees.)

ULMACEÆ.

Celtis occidentalis L.

Hackberry.

Habit. Tree, 12-15 meters (40-50 ft.) high, with straight, short trunk, 30-60 cm. or more in diameter, with a few large branches and many slender, rather horizontal, zigzag branchlets, forming a rounded, rather open crown; to a dwarfed and gnarly shrub.

Leaves. Alternate, simple, 5-10 cm. long and one-half as broad; ovate to ovate-lanceolate, oblique at the base, usually long-pointed; coarsely serrate above the entire base; thin, not strongly reticulate-veined beneath; glabrous, (in the variety *crassifolia,* very rough above), light green above, paler beneath, turning light yellow late in autumn; petioles short, slender, hairy.

Flowers. May, with or soon after the leaves; polygamo-monœcious; greenish; inconspicuous; on slender pedicels; the staminate in clusters at the base of the shoot, the pistillate usually solitary in the axils of the upper leaves; calyx greenish, deeply 5 lobed; corolla 0; stamens 5; ovary 1-celled.

Fruit. September-October, remaining on the tree through the winter; slender-stalked, fleshy, globular drupes, 8-11 mm. long, dark purple; edible.

Twigs in Winter. Twigs rounded, slender, zigzag, reddish-brown or grayish or blackish, slightly pubescent, somewhat shining. Pith rather small, white, rounded, closely chambered, or exceptionally continuous except at some or all of the nodes. Terminal bud absent; lateral buds light brown, 6 mm. long, ovoid, acute, flattened, the tip appressed, about 4 two-ranked scales. Leaf scars cresent shaped, somewhat raised; bundle scars 3, or the middle one divided; stipule scars narrow.

Bark and Wood. On old trunks thick, light brown or silvery gray, broken into deep, short ridges or warty excrescences. Wood heavy, soft, coarse-grained, weak, light yellow, with thick, whitish sapwood, fairly durable in contact with the soil.

Distribution in the State. Throughout.

Habitat. Prefers rich, moist, well-drained soil, but actually will grow almost anywhere that sufficient water is available.

Remarks. The peculiar bark and the presence of witches' brooms (dense clusters of dwarfed twigs due to the attacks of certain insects, mites or fungi) are the most striking features of the hackberry.

The variety *Celtis occidentalis crassifolia* (LaMarck) Gray, occurs sparingly at Manhattan and presumably elsewhere in the state.

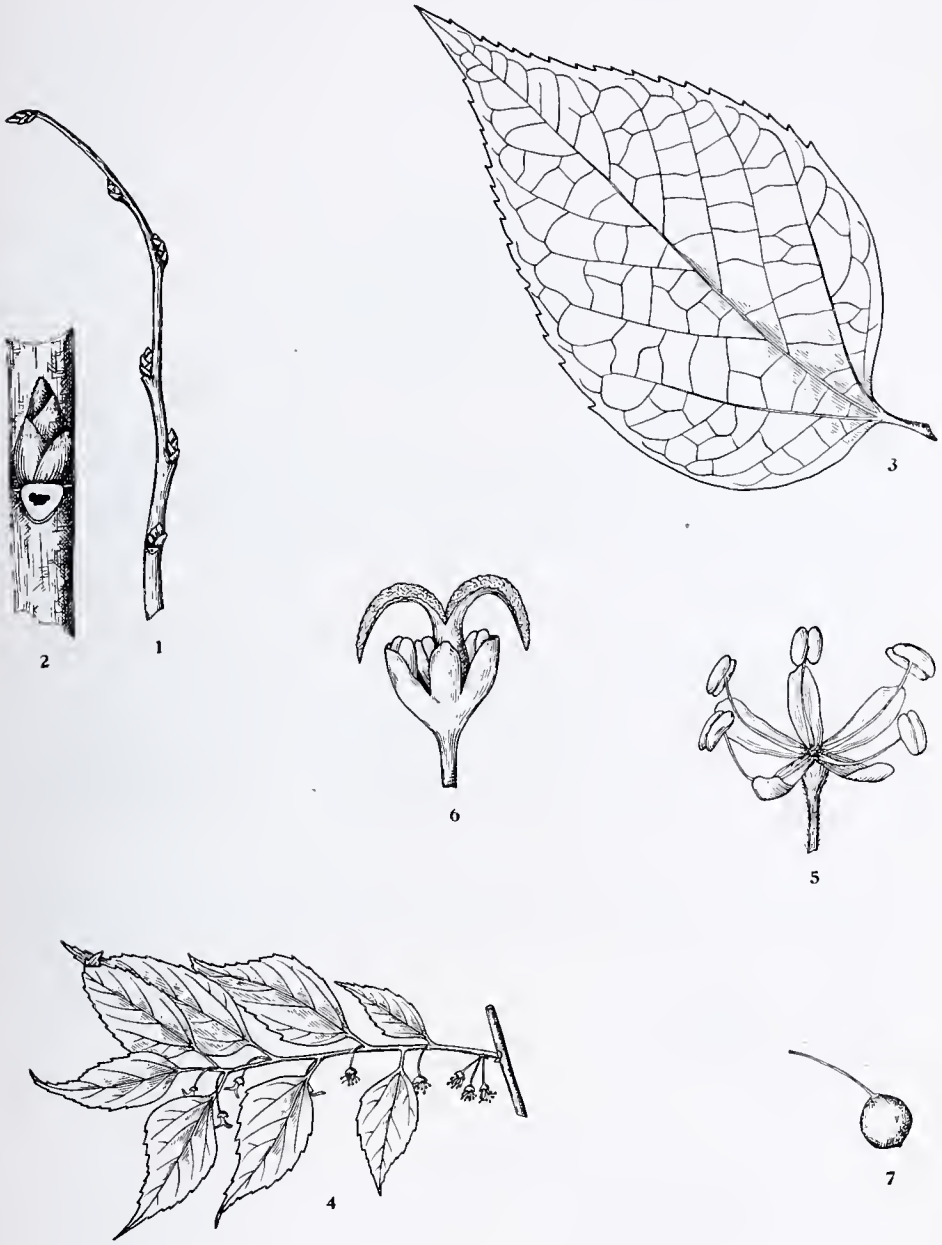

FIG. 132.—*Celtis occidentalis.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ¾.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

(From Otis: Michigan Trees.)

ULMACEÆ.

Celtis lævigata Willd.

(*C. mississippiensis.*)

Sugarberry.

Habit. A medium-sized tree.

Leaves. Alternate, simple, ovate or lanceolate, firm, shining, entire or with a few low teeth, 3-nerved and prominently pinnately veined, glabrous on both sides (in the variety *texana*, pubescent on the midrib and veins below), long acuminate, inequilateral and obtuse or cordate at base, 2.5 to 7 cm. long. 1.2 to 3.5 cm. wide.

Flowers. Similar to *Celtis occidentalis.*

Fruit. September-October, rather short-stalked, fleshy, globular drupes, 6-8 mm. in diameter.

Twigs in Winter. Dark, mostly smooth, rounded, slender, zigzag. Pith similar to *Celtis occidentalis.* Terminal bud absent; lateral buds ovoid, flattened, the tip appressed, 1-2 mm. long, 2-ranked. Leaf scars more or less crescent shaped, somewhat raised; bundle scars 3 or the middle one divided; stipule scars present.

Bark and Wood. Light gray, smooth except where irregular patches of rough, corky excrescences; wood similar to *Celtis occidentalis.*

Distribution in the State. The extreme southeastern counties, but planted elsewhere.

Habitat. Dry soil.

Remarks. Variable.

FIG. 133.—*Celtis lævigata.*

1. Top view of winter twig, x 1.
2. Side view of winter twig, showing chambered pith and variation in leaf scars, x 1.
3. Flower cluster, reduced.
4. Flower, enlarged.
5. Fruiting twig, x ½.
6. Fruit, x 1.

(Original.)

ULMACEÆ.

Celtis reticulata Torr.

Palo Blanco, Hackberry.

Habit. A small tree under 10 meters (33 ft.) in height, with stout branches, or dwarfed to a shrub.

Leaves. Thick, ovate, 7.5 cm. long or less, strongly reticulate-veined; acute, scabrous or nearly smooth above, pubescent beneath, entire or serrate above; the stout petioles 4-12 mm. long, on pubescent or nearly glabrous twigs.

Flowers. Mostly similar to *Celtis lævigata.*

Fruit. Red or orange-red, globular drupe, 8-13 mm. in diameter, on peduncles 10 mm. or less long, which are usually longer than the petioles.

Twigs in Winter. Brown, densely pubescent. Pith cylindrical, solid with firmer plates or chambered. Terminal buds absent; lateral buds ovoid, flattened, 2-ranked, about 1.5 times as high as broad. Leaf scars somewhat triangular, somewhat raised; bundle scars 3; stipule scars present.

Bark and Wood. Smooth, gray bark roughened with corky warts and ridges sometimes as high as 3 cm.

Distribution in the State. Southwestern.

Habitat. Along rivers in rocky or gravelly soil.

Remarks. Reaching its northeastern limits in the state.

Celtis rugulosa Rydb.

Habit. A small tree, 5-10 meters (16-33 ft.) high; with rounded crown.

Leaves. Thick; broadly ovate, oblique, 4-7 cm. long; short acuminate; somewhat cordate at the base; sharply serrate except at the base; dark green, very shiny and slightly scabrous above; brownish or yellowish green, dull, puberulent beneath, strongly reticulate and rugose; petioles 6-10 mm. long.

Flowers. Mostly similar to *Celtis lævigata.*

Fruit. Brownish, globose drupe about 8 mm. in diameter with short but evident style; peduncles 15-25 mm. long.

Twigs in Winter. Brownish, slender, pubescent. Pith cylindrical, solid, with firmer plates or chambered. Terminal bud absent; lateral buds lanceolate, flattened, 2-ranked, about twice as high as broad. Leaf scars somewhat oval, somewhat raised; bundle scars 3; stipule scars present.

Bark and Wood. Bark gray, corky.

Distribution in the State. Western.

Habitat. Gulches along rivers.

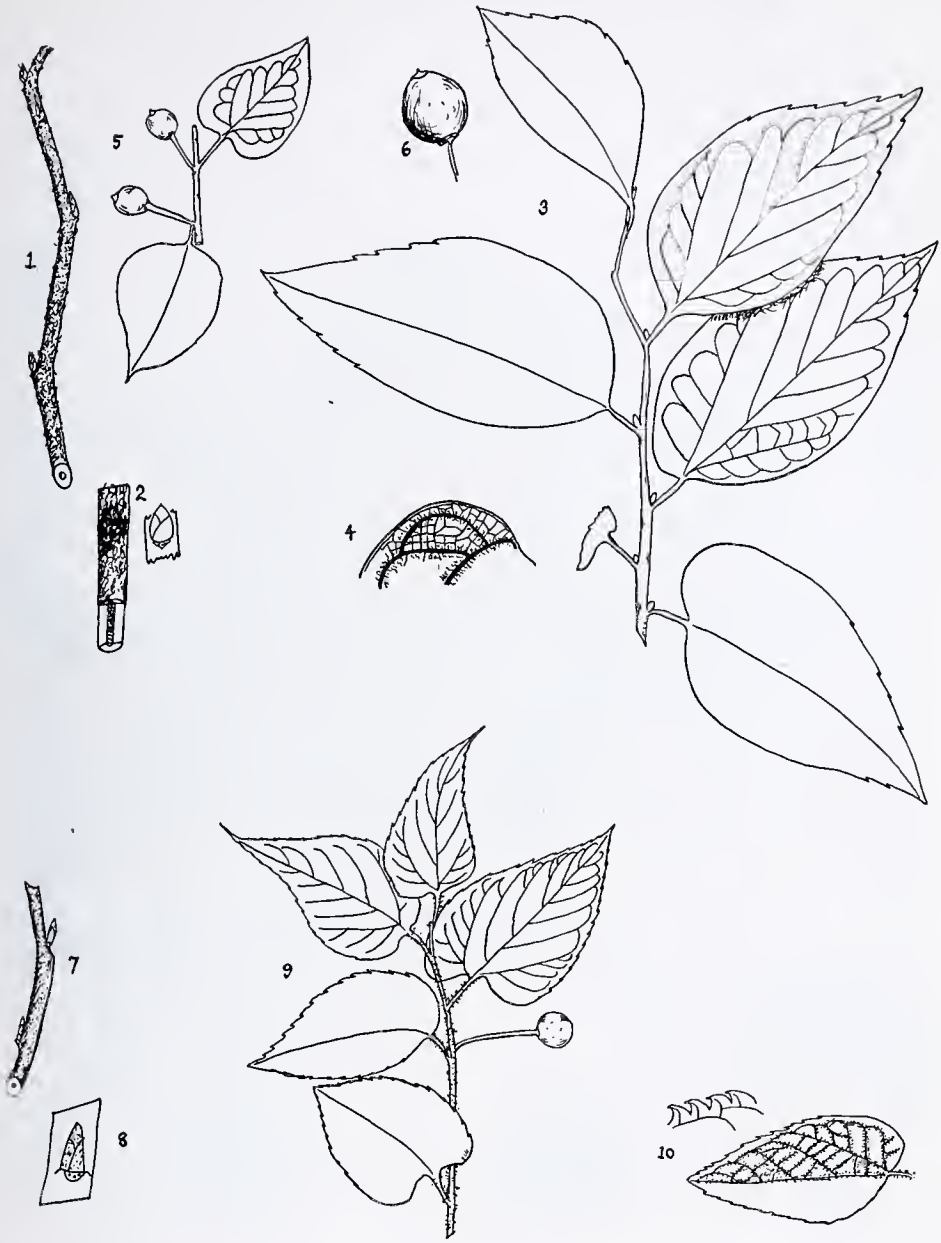

FIG. 134.—*Celtis reticulata and Celtis rugulosa.*

Celtis reticulata.

1. Winter twig from above, x ½.
2. Winter twig, from side, x 1.
3. Twig, showing leaves.
4. Detail of the veining on under surface of leaf, enlarged.
5. Fruiting twig, x ½.
6. Fruit, x 1.

Celtis rugulosa.

7. Winter twig from above, x ½.
8. Portion of the twig, showing bud and leaf scar, enlarged.
9. Fruiting twig, x ½.
10. Leaf from below, showing veining and detail of the margin, enlarged.

(Original.)

ULMACEÆ.

Ulmus fulva Michaux.

Slippery Elm, Red Elm.

Habit. A medium-sized tree, 9-15 meters (30-50 ft.) high with a short trunk 30-60 cm. in diameter; spreading branches form a broad, open, flat-topped crown.

Leaves. Alternate, simple, 10-18 cm. long, about one-half as broad; ovate-oblong; coarsely doubly serrate; thick and firm; dark green and rough above, paler and somewhat rough beneath; petioles short, stout, hairy.

Flowers. March, before the leaves; mostly perfect borne on short pedicels in crowded fascicles; calyx campanulate, 5-9-lobed, green, hairy; corolla 0; stamens 5-9, with dark red anthers; stigmas 2, reddish purple.

Fruit. April-May; semi-orbicular, 1-seeded samaras, short-stalked in dense clusters; seed cavity brown-tomentose; wings smooth, nearly 2 cm. long.

Twigs in Winter. Twigs rather slender, zigzag, terete, grayish or light brown. Pith small, rounded, continuous. Terminal bud absent; lateral buds narrowly (embryonic leafy branches) or very broadly (embryonic flowering branches) ovoid, oblique, dark brown, rusty-tomentose, scales about 6, 2-ranked. Leaf scars half-round, scarcely raised; bundle scars 3 or in 3 groups; stipule scars unequal.

Bark and Wood. Thick on old trunks, dark red-brown, shallowly fissured into large, loose plates; inner bark mucilaginous. Wood heavy, hard, strong, very close-grained, durable, easy to split while green; dark red-brown, with thin, lighter colored sapwood.

Distribution in the State. Eastern half, but also in counties in the northwestern part of the state.

Habitat. Prefers stream banks and bottom lands; rich, moist hillsides; rocky ridges and slopes.

Remarks. Valuable as timber, a source of a medicinal bark and one of the most desirable trees for street planting in the state.

FIG. 135.—*Ulmus fulva.*

1. Winter twig, x 2.
2. Leaf, x 1.
3. Flowering branchlet, x 1.
4. Perfect flower, enlarged.
5. Fruit, x 1.

(From Otis: Michigan Trees.)

ULMACEÆ.

Ulmus americana L.

American or White Elm.

Habit. A large tree 12-20 meters (40-65 ft.) high, with a trunk diameter of 60-100 cm.; commonly dividing 3-8 meters above the ground into a few large branches which rise upward and outward to form a vase-shaped outline, or more rarely a rounded crown.

Leaves. Alternate, simple, 10-15 cm. long, one-half as broad; obovate-oblong to oval; coarsely doubly serrate; thick and firm; dark green and rough above, pale and pubescent or glabrous beneath; petioles short and stout.

Flowers. February-March, before the leaves; mostly perfect; small, brown to red; borne on slender pedicels in loose fascicles; calyx campanulate, 5-9-lobed; corolla 0; stamens 4-9, with bright red anthers; ovary 2-celled; styles 2, green.

Fruit. April; ovate, 1-seeded samaras, smooth both sides, hairy on the margin, 12 mm. long, long-stemmed in crowded clusters.

Twigs in Winter. Twigs rather slender, zigzag, terete, reddish-brown or grayish-brown, glabrous. Pith small, rounded, continuous. Terminal bud absent; lateral buds narrowly (embryonic leafy branches) or broadly (embryonic flowering branches) ovoid, oblique, acute, flattened, glabrous, brown, about 3 mm. long, 2-ranked, with 6 or more visible scales. Leaf scars about half-round, scarcely raised; bundle scars 3 (or 3 groups); stipule scars unequal.

Bark and Wood. On old trunks thick, ash-gray, deeply fissured into broad, scaly ridges. Wood heavy, hard, strong, rough, difficult to split; grain coarse, winding, light brown, with thick, lighter colored sapwood.

Distribution in the State. At least the eastern three-fourths.

Habitat. Prefers deep, rich, moist loam, bottom lands, stream banks.

Remarks. One of the most commonly planted street trees, but not sufficiently free from insect attack.

FIG. 136.—*Ulmus americana.*

1. Winter twig, x 2.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Flower, enlarged.
5. Fruit, x 2.

(From Otis: Michigan Trees.)

ULMACEÆ.

Ulmus racemosa Thomas.

Rock Elm, Cork Elm.

Habit. A large tree but not over 15 meters (50 ft.) in the state and a trunk diameter of 60 cm., strongly drooping lateral and lower branches form a narrow, oblong crown.

Leaves. Alternate, simple, 8-15 cm. long, one-half as broad; obovate to oblong-oval; coarsely doubly serrate; thick and firm; shining, dark green above, pale-pubescent beneath; petioles pubescent, 6 mm. long.

Flowers. March-April, before the leaves; mostly perfect; greenish; borne on slender, drooping pedicels in loose racemes; calyx campanulate, 7-8-lobed; corolla 0; stamens 7-8, with purple anthers; ovary hairy, 2-styled.

Fruit. May; ovate, 1-seeded samaras, pubescent all over, 12 mm. long, wing narrow in proportion to the seed.

Twigs in Winter. Light brown and hairy, but soon reddish-brown and shiny, finally dark brown or ashy gray, with corky, irregular ridges or wings in the second year. Pith small, rounded, continuous. Terminal bud absent; lateral buds ovoid, acute, brown, pilose, about 6 mm. long. Leaf scars about half-round, scarcely raised; bundle scars 3 (or 3 groups); stipule scars unequal.

Bark and Wood. Thick and grayish on the trunk, with wide fissures separating broad, flat, scaly ridges. Wood heavy, very strong and tough, close-grained, light red-brown, with thick, lighter colored sapwood.

Distribution in the State. According to our records only in Smith county, but probably elsewhere. Planted at Manhattan.

Habitat. Dry, gravelly uplands; rocky ridges and slopes; heavy clay soils; river-banks.

Remarks. A valuable tree on account of its wood.

FIG. 137.—*Ulmus racemosa.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Flowering branchlet, x 1.
5. Flower, enlarged.
6. Fruit, x 1.

(From Otis: Michigan Trees.)

ULMACEÆ.

Ulmus pumila L.

Elm, Chinese Elm.

Habit. A small, rapid-growing tree, with main branches ascending.

Leaves. Alternate, 2-ranked, simple, 4-7 cm. long, about half as broad; oblong-oval, often rhombic, serrate, firm; dark green above, pale green below; short petioled.

Flowers. March, before the leaves, mostly perfect, purplish, on very short pedicels in fascicles, calyx campanulate, 4-5 lobed; corolla 0; stamens usually 4, with purple anthers, 2 styles, stigmatic on inner surface. Odor when dried similar to that of Ulmus fulva.

Fruit. April, May; glabrous; obliquely obovoid, notched deeply at the apex; 14-17 mm. long, about as wide; nutlet central, reaching close to the base of the notch.

Twigs in Winter. Very slender, grayish-brown, somewhat pubescent. Pith small, rounded, continuous. Terminal bud absent; lateral buds narrowly (embryonic leafy branches) or broadly (embryonic flowering branches) ovoid, tiny, oblique; 4 visible scales, somewhat pubescent, less than 1.5 mm. long; flower buds may be longer or show more scales late in winter. Leaf scars half round, scarcely raised; bundle scars 3; stipule scars unequal.

Bark and Wood. Dark brown, shallowly fissured; inner bark mucilaginous.

Distribution in the State. Records are not yet available as to the extensiveness of planting.

Habitat. Uplands.

Remarks. A comparatively recent introduction, which is proving to be a very valuable tree for planting in the prairie states.

In Gage Park, Topeka, Kan., there are two specimens of *Ulmus pumila,* which were planted in 1916 and are now (1928) at least 60 feet in height.

Other "Chinese" elms are also being introduced, as *Ulmus japonica* Sarg., with slender, somewhat pendulous, densely pubescent and minutely tuberculate, yellowish or pale brown, sometimes corky-ridged twigs; ovoid, bluntly acute buds, about 4 mm. long, with scales slightly ciliate-margined; short petioled leaves, firm, rough on both surfaces; subsessile flowers in parts of 4's; and obovate-oblong fruits, 9-11 mm. long, notched at the apex down to the nutlet, narrowed towards the base, very minutely and scantily pubescent; and perchance *Ulmus parvifolia* Jacq., flowering in late summer, is a half evergreen tree up to 20 meters high or shrubby, with grayish scaly bark and moderately slender twigs with fine grayish pubescence; ovoid scaly buds at least 2 mm. long, the scales finely pubescent and ciliate; leaves rather leathery, 2-5 cm. long, oblong-ovate or nearly so, simply serrate, smooth and shiny above, pubescent beneath, at least when young, on a short pubescent petiole; flowers short pedicelled in axillary clusters mostly towards the base of the current year's growth, appearing in August, stamens 4-5 with purple anthers; fruit approaching elliptical, 9-13 mm. long, cut in at the apex, nutlet central in the wing. The leaves are retained during the winter in the south.

Ulmus alata Michx., the winged elm, native farther southeast, is sometimes planted. It is easily recognized by the thick corky ridges and the very sharp-pointed buds.

Ulmus glabra Huds, the English or Wych elm, a native of Europe, may be planted.

FIG. 138.—*Ulmus pumila.*

1. Winter twig from above, x 1.
2. Portion of the twig from above, x 2.
3. Portion of the twig, showing "flower" bud.
4. Portion of a very slender side branch, x 3.
5. Twig, showing fascicles of flowers.
6, 7. Leaves, showing variations in shape, x ½.
8. Details of margin, enlarged.
9. Single flower, x 3.
10. Twig with cluster of fruits.
11. Individual fruits, x 1.
12. Seedling, x ½.

(Original.)

MORACEÆ.

Toxylon pomiferum Raf. (*Maclura pomifera* Schneid.).

Osage Orange.

Habit. Tree growing naturally to about 9 meters (30 ft.) in height, but usually trimmed below this in hedges; trunk short with upwardly arching branches, forming a low, rounded crown.

Leaves. Alternate, simple, 7-15 cm. long, 2.5 to 5 cm. broad; ovate to oblong-lanceolate; entire; thick and firm; dark green and shining above, paler beneath; petioles slender, more or less pubescent, 4-5 cm. long; juice more or less milky.

Flowers. June, after the leaves; diœcious; the staminate slender-pedicelled, borne in a dense raceme at the end of long, slender, drooping peduncles; the pistillate in dense, globose heads at the end of short, stout peduncles in axils; calyx 4-lobed, hairy; corolla 0; stamens 4; style covered with white, stigmatic hairs.

Fruit. Autumn; pale green, orangelike, 5-13 cm. in diameter, composed of numerous small drupes, crowded and grown together; seeds brown.

Twigs in Winter. Twigs moderate or small, rounded, glabrous; the longer commonly zigzag, armed with stout, straight, axillary spines, which decrease in size towards the tip. Pith moderate, cylindrical, pale, continuous. Terminal bud absent; lateral buds depressed-globular, partly hidden in the bark, pale brown. Leaf scars approaching half-round or broadly triangular, somewhat raised; bundle scars several, variously arranged in 3 groups or a transverse aggregate; stipule scars small or the small stipules persistent.

Bark and Wood. Bark of twigs at first bright green, pubescent, becoming orange-brown; becoming dark orange-brown on the trunk, and deeply furrowed. Wood heavy, very hard and strong, flexible, coarse-grained, very durable, but difficult to work, bright orange, with thin, lemon-colored sapwood.

Distribution in the State. Native in the southeastern and eastern parts of the state, but planted in hedges quite generally.

Habitat. Rich soils.

Remarks. Less used as a hedge plant than formerly.

FIG. 139.—*Toxylon pomiferum.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x ½.
7. Pistillate flower, enlarged.
8. Fruit, x ¼.

(From Otis: Michigan Trees.)

MORACEÆ.

Morus rubra L.

Red Mulberry.

Habit. A small tree, 4-9 meters (13-30 ft.) high, trunk diameter 8-30 cm., trunk short; numerous stout-spreading, more or less zigzag, branches form a dense, broad, round-topped crown in which there are many slender whip-like branchlets.

Leaves. Alternate, simple, 8-13 cm. long, nearly as broad; outline variable, ovate to semiorbicular, often 3-5-lobed; coarsely serrate; thin; dark blue-green and smooth or rough above, pale and more or less downy beneath; petioles 2.5 to 5 cm. long, smooth, exuding a milky juice when cut.

Flowers. May, with the leaves; monœcious or diœcious; the staminate in dense spikes 2.5 to 5 cm. long, on short, hairy peduncles; the pistillate in dense spikes about 2.5 cm. long, on short, hairy peduncles; calyx 4-lobed, hairy; corolla 0; stamens 4, with green anthers; stigmas 2, spreading.

Fruit. July, 2.5 cm. long; consisting of drupes about 1 mm. long, each inclosed in a thickened, fleshy calyx; berry-like; bright red at first, finally blackish; sweet, juicy, edible.

Twigs in Winter. Moderate or rather slender, smooth and brownish. Pith rounded, moderate, continuous. Terminal bud absent; lateral buds ovoid, abruptly pointed, 6-8 mm. long, somewhat spreading, oblique, the 2-ranked thin scales greenish or brownish, darker margined. Leaf scars round or half round, somewhat raised; bundle scars numerous and scattered or in an ellipse; stipule scars narrow, the one below the bud larger.

Bark and Wood. Trunk dark brown tinged with red, and more or less furrowed, becoming somewhat scaly. Wood light, soft, weak, rather tough, coarse-grained, very durable; pale orange, with thick, lighter colored sapwood.

Distribution in the State. Eastern half, but sparingly.

Habitat. Prefers rich soil in river bottoms.

Remarks. Planted for fence post material.

Morus alba L. (White Mulberry), a tree or shrub of various shapes is frequently planted. It differs from the Red Mulberry in winter in having shorter lateral buds (less than 6 mm.), which have little if any darker margin to the bud scales, and in having the buds appressed rather than somewhat obliquely spreading. In summer, the appressed buds with uniformly margined scales and the almost or quite smooth leaves distinguish it from the Red Mulberry, with its spreading buds, dark-margined scales and leaves rough above.

FIG. 140.—*Morus rubra.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Spike of staminate flowers, x 1.
5. Staminate flower, enlarged.
6. Spike of pistillate flowers, x 1.
7. Pistillate flower, enlarged.
8. Fruit, x 1.

(From Otis: Michigan Trees.)

RUTACEÆ.

Zanthoxylum americanum Mill.

Prickly Ash.

Habit. A shrub or small tree, usually under 5 meters (16 ft.) high; crown irregular.

Leaves. Alternate, odd-pinnate, pubescent when young but usually glabrous when mature; leaflets 3-11, ovate, opposite, dark green above, lighter below, nearly sessile, 4-5 cm. long, entire or finely crenate, glandular-dotted, stipules absent.

Flowers. April, before the leaves; about 3 mm. broad, imperfect, in sessile axillary cymes, greenish; pedicels slender; calyx 0; petals 4-5; stamens 3-5 hypogynous; pistils 2-5.

Fruit. May-June, fleshy, ellipsoid; black, about 4 mm. long, on a short stipe, 1-2 seeded.

Twigs in Winter. Moderate, nearly round, dark brownish. Pith rounded, continuous, creamy white. Buds superposed, globose, red-woolly and indistinctly scaly. Leaf scar broadly triangular, a little raised on an articular membrane, and between 2 prickles which are much widened at the base; bundle scars 3.

Bark and Wood. Bark dark. Wood soft, light brown.

Distribution in the State. Eastern third, extending farther west in the northern part of the state than at the southern border.

Habitat. In moderately dense woods along streams.

Remarks. *Zanthoxylum clava-herculis* L., the Southern Prickly Ash or Hercules Club, is recorded from Comanche county in Sudworth's "Check List." It differs in having glabrous buds, no articular membrane, slender, not greatly dilated prickles, flowers in large terminal compound cymes, and with calyx present.

Ptelea trifoliata L. (Hoptree), as present in Kansas, is a shrub, although southward it becomes a small tree. It is easily recognized by its trifoliolate, alternate, compound leaves and clusters of fruits winged completely around.

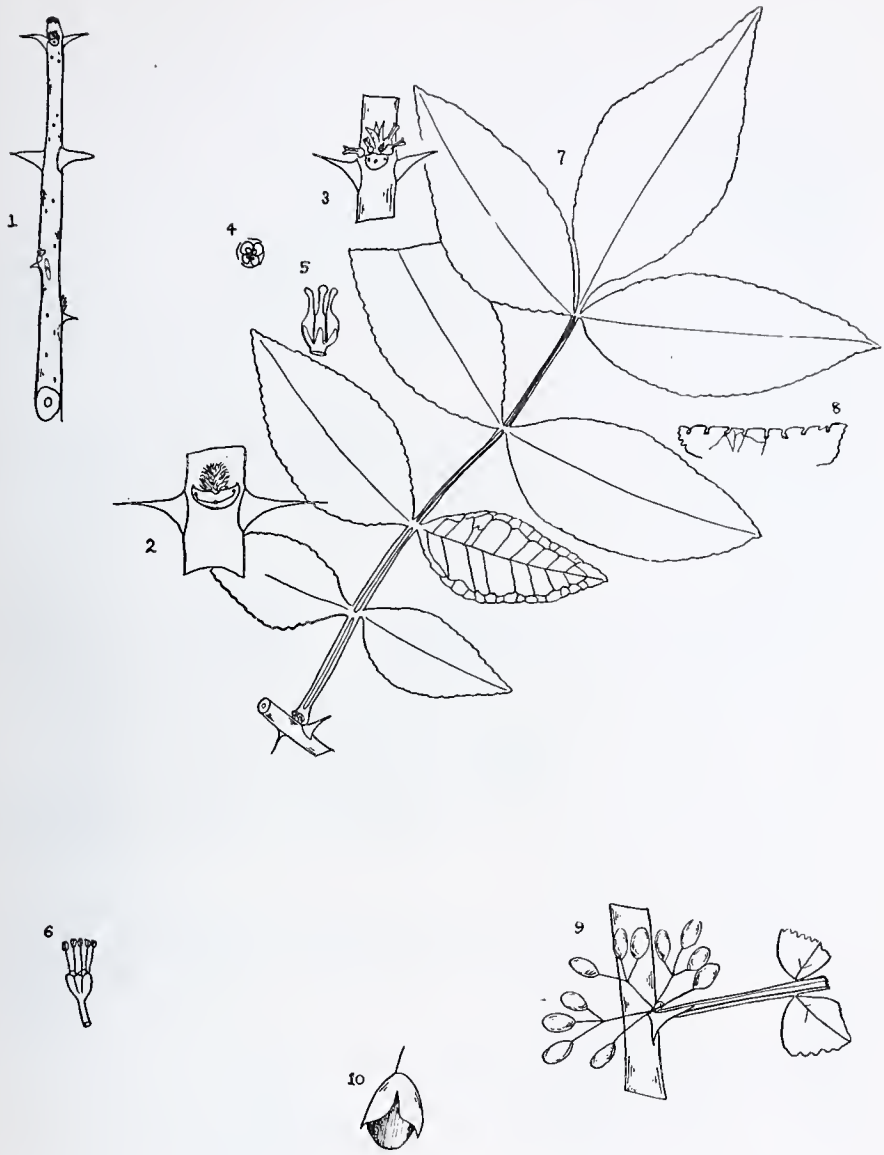

FIG. 141.—*Zanthoxylum americanum.*

1. Winter twig, x 1.
2. Portion of the twig, showing buds and prickles, x 2.
3. Portion of twig, showing flowers.
4. Floral diagram.
5. Pistillate flower, enlarged.
6. Staminate flower, enlarged.
7. Leaf, x ½.
8. Margin of a leaflet, enlarged.
9. Portion of a twig, showing cluster of fruits, reduced.
10. Single fruit, x 1.

(Original.)

SIMARUBACEÆ.

Ailanthus altissima (Mill.) Swingle (*A. glandulosa* Desf.).

Ailanthus, Tree of Heaven.

Habit. A tall, bare, rapidly-growing tree, up to about 15 meters (50 ft.) in height, and a trunk diameter of about 60 cm.; crown spreading, open, made up of a few large coarse branches.

Leaves. Alternate, odd-pinnately compound, 0.3-1 meter long. Leaflets 11-41 in number, 5-15 cm. long and about one-third as broad; ovate-lanceolate; entire with the exception of two or more coarse, glandular teeth at the base; glabrous, dark green above, paler beneath, turning a clear yellow in autumn or falling without change; ill-scented. Petioles smooth, terete, swollen at the base.

Flowers. June, when the leaves are full grown; polygamo-diœcious; small, yellow-green, borne in upright panicles 15-30 cm. or more in length; calyx 5-lobed, petals 5, greenish, hairy; stamens 10. Staminate flowers ill-scented, pistillate almost free from odor.

Fruit. October; 1-celled, 1-seeded samaras, spirally twisted, reddish or yellow-green; borne in crowded clusters, frequently persisting into winter.

Twigs in Winter. Coarse, yellowish to red-brown, velvety-downy, lenticels very conspicuous. Pith large, homogeneous, white to brownish. Terminal bud absent; lateral buds about 3 mm. long, subglobose, with 2 or 4 exposed scales, brownish, downy; leaf scars very large, shield- or heart-shaped, with about 9 bundle scars; no stipule scars.

Bark and Wood. Bark rather smooth with prominent, much-widened lenticels for a time; thin, grayish and shallowly fissured on old trunks. Wood soft, weak, of coarse and open grain, pale yellow, satiny, with thick, lighter colored sapwood.

Distribution in the State. Established in the central eastern part of the state and planted frequently in at least the eastern half.

Habitat. Uplands; spreading by seeds and suckers.

Remarks. A native of China. Usually prized as an ornamental tree.

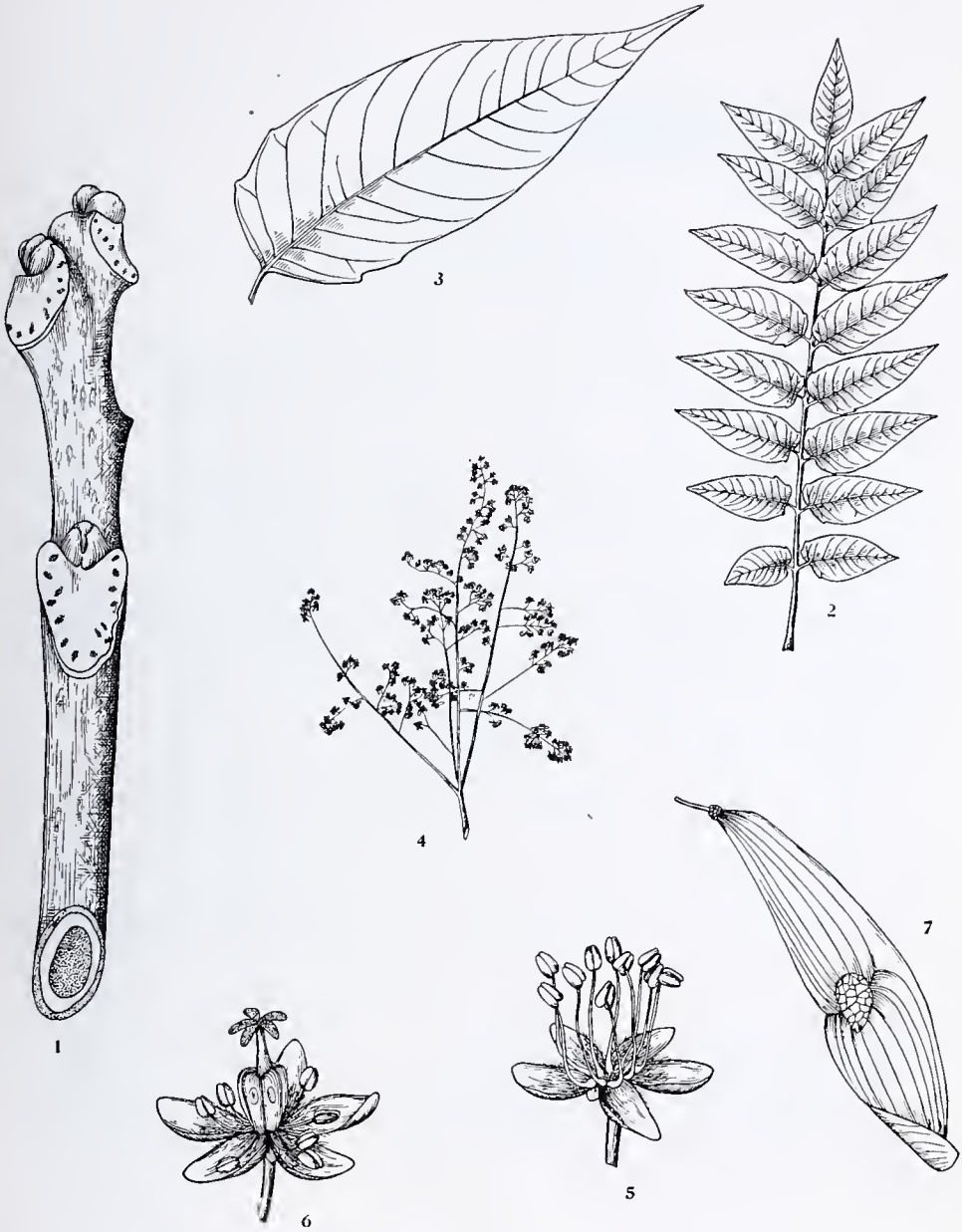

FIG. 142.—*Ailanthus altissima.*

1. Winter twig, x 1.
2. Leaf, x ⅛.
3. Leaflet, x ½.
4. Staminate inflorescence, x ¼.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

(From Otis: Michigan Trees.)

SALICACEÆ.

Salix longifolia Muehl.
(*Salix interior* Rowlee).

Sandbar Willow, Longleaf Willow.

Habit. A small tree, seldom over 9 meters (30 ft.) high and trunk diameter 5-13 cm.; branches slender, flexible, erect forming a narrow elongated or a round-topped crown; quite commonly dwarfed to shrubs 1.5 to 2 meters high, growing densely together.

Leaves. Alternate, simple, linear-lanceolate, often more or less curved, gradually narrowed at both ends, 5-15 cm. long, 3-8 mm. wide; shallow glandular teeth; soft-silky when young, at maturity thin, smooth; light yellowish green, paler beneath, midrib yellow; petioles 3-6 mm. long, grooved.

Flowers. Early summer in catkins, diœcious; staminate catkins on short, stout peduncles, cylindrical, soft, pale-silky 4-5 cm. long; scales entire, light yellowish green, bearing 2 stamens; pistillate catkins about 2.5 cm. long; greenish, crowded, elongating in fruit; ovary oblong acute, short-stalked, silky.

Fruit. Summer, 1-celled capsule, light brown, 6 mm. long; in crowded catkins 5-8 cm. long; seeds tiny, brownish, covered with long silky hairs.

Twigs in Winter. Slender, flexible, smooth, gray, light yellow or dark orange or reddish. Pith rather small, roundish, continuous, white. Terminal bud absent; lateral buds ovate, narrow, acute, chestnut-brown, about 3 mm. long. Leaf scars little curved if at all; bundle scars 3; stipule scars present.

Bark and Wood. Bark thin, smooth or shallowly fissured, and more or less fine scaly, often tinged with red. Wood soft, light close-grained, more or less satiny, weak, brittle, light brown with lighter colored or almost white sapwood.

Distribution in the State. Throughout the state.

Habitat. Banks of streams, borders of lakes, ponds and swamps, and especially on sandbars, whence its name.

Remarks. A pioneer in revegetating wet, sandy areas, usually the first relatively permanent vegetation on river islands. Useful in riprapping to minimize erosion of stream banks.

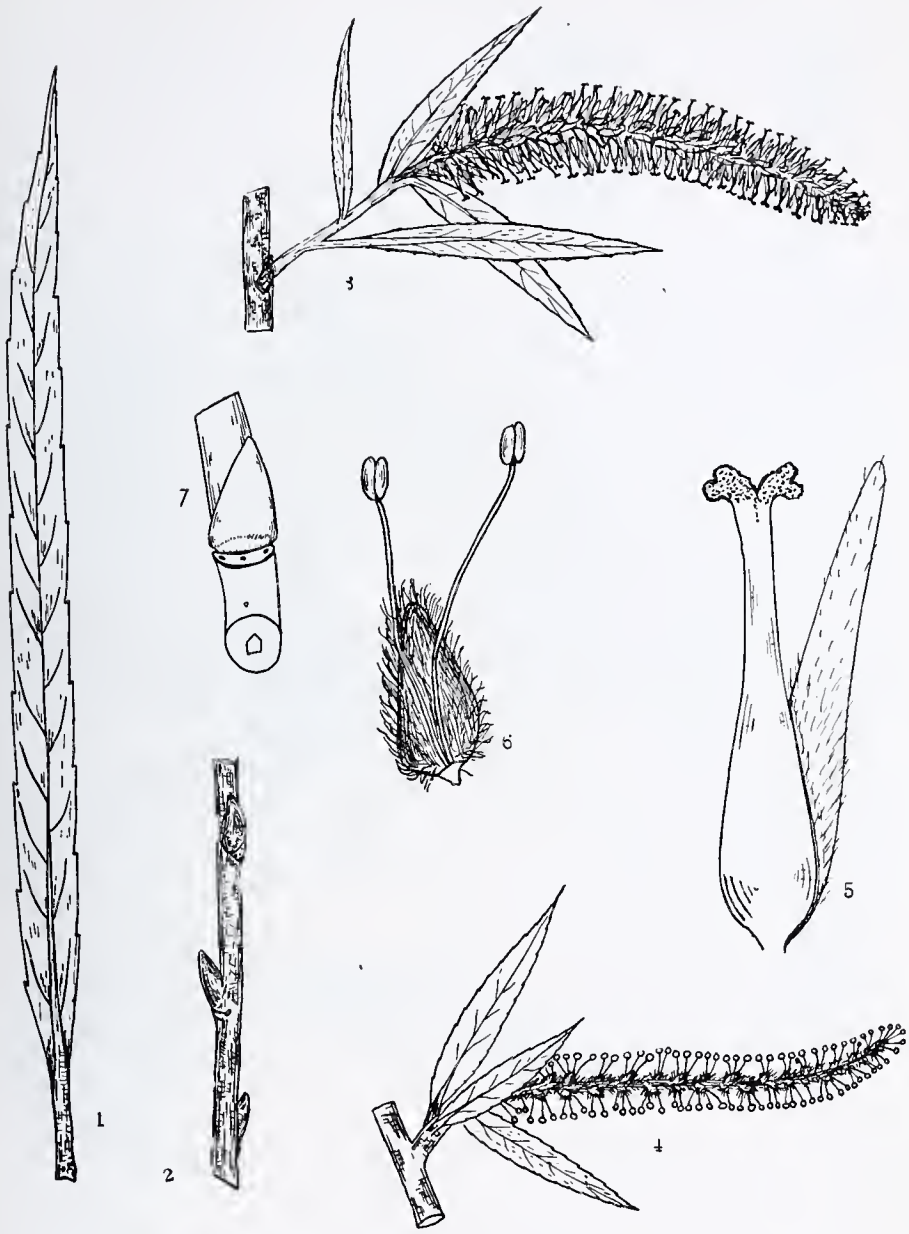

FIG. 143.—*Salix longifolia.*

1. Leaf, x 1.
2. Winter twig, x 2.
3. Pistillate flowering branchlet, x 1.
4. Staminate flowering branchlet, x 1.
5. Pistillate flower and bract, enlarged.
6. Staminate flower and bract, enlarged.
7. Portion of a twig, showing bud and leaf scar, x 4. (Original.)

(1-6 from Pool: Nebraska Trees.)

SALICACEÆ.

Salix amygdaloides Anders.

Peachleaf or Almondleaf Willow.

Habit. Tree, up to 12 meters (40 ft.) high and trunk diameter up to 50 cm., straight trunk, straight ascending branches forming a rather narrow rounded crown.

Leaves. Alternate, simple, 5-13 cm. long, 18-30 mm. broad; lanceolate to ovate-lanceolate, long-pointed; finely serrate; thin and firm; light green and shining above, pale and glaucous beneath; petioles slender, 12-18 mm. long.

Flowers. April-May, with the leaves; diœcious; borne in crowded, slender, pubescent catkins 5-8 cm. long; calyx 0; corolla 0; scales yellow, villous both sides; stamens 5-9; ovary oblong-conical, with stigmas nearly sessile.

Fruit. May; 1-celled, globose-conical capsule 6 mm. long, containing many minute seeds which are furnished with a tuft of long, silky, white hairs.

Twigs in Winter. Slender, glabrous, shining, dark orange or red-brown becoming darker orange-brown. Pith rather small, roundish, continuous, white. Terminal bud absent; lateral buds broadly ovoid, swollen on one side, shining, dark brown, about 3 mm. long. Leaf scars linear, narrow, with 3 bundle scars; stipule scars present.

Bark and Wood. Thick and brown on old trunks, irregularly fissured into flat, connected ridges. Wood light, soft, weak, close-grained, light brown, with thick, whitish sapwood.

Distribution in the State. Apparently throughout, but fewer records from the southwestern counties.

Habitat. Banks of streams or ponds.

Remarks. Not usually very desirable. Can be propagated by cuttings.

Salix longipes wardii (Bebb) Schneider (*S. wardii* Bebb) is recorded from along streams in eastern Kansas. It has 3-6 stamens and the leaves are silvery-whitish beneath, without glands on the petioles.

FIG. 144.—*Salix amygdaloides.*

1. Winter twig, x 1.
2. Lateral bud, enlarged.
3. Leaf, x 1.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x ½.
7. Pistillate flower, enlarged.
8. Fruiting branchlet, x ½.

(From Otis: Michigan Trees.)

SALICACEÆ.

Salix nigra Marsh.

Black Willow.

Habit. Tree, up to 12 meters (40 ft.) high and trunk diameters of about 50 cm.; trunk short, often bent; stout, spreading branches form a broad, rather irregular open crown. Sometimes a much branched shrub.

Leaves. Alternate, simple, 5-13 cm. long, 12-18 mm. broad; lanceolate, very long-pointed, often curved at the tip; finely serrate; thin; bright green and rather shining above, paler and often hairy beneath; petioles very short, more or less pubescent.

Flowers. March-April, with the leaves or before them; diœcious; borne in crowded, slender, hairy catkins, 2.5 to 7.5 cm. long; calyx 0; corolla 0; scales yellow, villous; stamens 3-6; ovary ovoid-conical, short-stalked, with stigmas nearly sessile.

Fruit. June; ovoid-conical capsule, 3 mm. long, containing many minute seeds which are furnished with a tuft of long, silky, white hairs.

Twigs in Winter. Glabrous or pubescent, bright red-brown, becoming darker with age, slender. Pith rather small, roundish, continuous, white. Terminal bud absent; lateral buds narrow-conical, acute, shining, red-brown, about 3 mm. long, a single exposed scale; stipule scars present.

Bark and Wood. Thick, dark brown or nearly black on old trunks, deeply divided into broad, flat ridges, often becoming shaggy. Wood light, soft, weak, close-grained, light red-brown, with thin, whitish sapwood.

Distribution in the State. Records show it in the eastern half and the southern part of the western half, but it probably would grow anywhere with sufficient water.

Habitat. Banks of streams and lake shores, but will grow in somewhat drier soil.

Remarks. Very useful in minimizing erosion along streams or at the heads of ravines. Branchlets are brittle at base, and being broken off are frequently the means of propagation.

Perhaps one or two additional willows reach tree size in the state and should be included, notably, the cultivated *Salix vitellina* L. (Golden or Yellow Willow) and the native *Salix missouriensis* Bebb (Heart-leaved or Diamond Willow) in the eastern part of the state.

FIG. 145.—*Salix nigra.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Staminate flowering branchlet, x 1.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x 1.
7. Pistillate flower, enlarged.
8. Fruiting branchlet, x 1.

(From Otis: Michigan Trees.)

SALICACEÆ.

Populus alba L.

White Poplar.

Habit. A large tree, 15-18 meters (50-60 ft.) high, with trunk diameter of 60-90 cm., forming a large, spreading, rounded or irregular crown of large, crooked branches and sparse, stout branchlets.

Leaves. Alternate, simple, 5-10 cm. long and almost as broad; broadly ovate to suborbicular; irregularly toothed, wavy margined, or sometimes 3-5-lobed; glabrous, dark green above, white-tomentose to glabrous beneath; petioles long, slender, flattened, tomentose.

Flowers. April-May, before the leaves; diœcious; the staminate catkins thick, cylindrical, 5-10 cm. long; the pistillate catkins slender, pendulous, 2.5 to 5 cm. long; calyx 0; corolla 0; stamens 6-16, with purple anthers; stigmas 2, branched, yellow.

Fruit. May-June; ovoid, 2-valved capsules, 3-6 mm. long, borne in drooping catkins 5-10 cm. long; seeds light brown, surrounded by long, white hairs.

Twigs in Winter. Moderate, terete or nearly so, greenish, covered with a white down, becoming greenish gray and marked with darker blotches. Pith rather small, 5-angled, subcontinuous, brown. Buds ovoid, pointed, not viscid nor resinous, about 6 mm. long. Leaf scars somewhat 3-lobed, large; bundle scars 3, often compound; stipule scars present.

Bark and Wood. Dark gray or almost black, and fissured at the base of old trunks. Wood light, soft, weak, difficult to split, reddish yellow, with thick, whitish sapwood.

Distribution in the State. Not native, but occasionally planted.

Habitat. Prefers rich, moist soil, but will grow in poorer, drier soil.

Remarks. A desirable ornamental tree, suckering fairly freely.

FIG. 146.—*Populus alba.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 2.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x ½.
7. Pistillate flower, enlarged.
8. Fruit, x ½.

(From Otis: Michigan Trees.)

SALICACEÆ.

Populus nigra italica Du Roi.

Lombardy Poplar.

Habit. A tree 15-25 meters (50-80 ft.) high, with a short, ridged and buttressed trunk 60-100 cm. or more in diameter, and a narrow, spirelike crown of many erect branches and twigs.

Leaves. Alternate, simple, 5-9 cm. long, and usually somewhat broader than long; broad-deltoid, abruptly acuminate; finely but bluntly crenate-serrate; thick and firm; dark green and shining above, paler beneath; golden-yellow in autumn, petioles slender, laterally compressed, 2.5 to 5 cm. long.

Flowers. April-May, before the leaves; diœcious; the staminate is sessile, dark red, cylindrical catkins about 7.5 cm. long; the pistillate not present in the United States; calyx 0; corolla 0; stamens about 8, with white filaments and purple anthers.

Fruit. Not formed in the United States in the absence of pistillate flowers.

Twigs in Winter. Slender, flexible, long, glabrous, shining yellow, becoming gray. Pith rather small, 5-angled, brownish. Terminal bud conical, slightly angled, taper-pointed, glutinous, about 1 cm. long; lateral buds smaller, appressed. Leaf scars broad; bundle scars 3, sometimes compound; stipule scars present.

Bark and Wood. Thick and gray-brown or almost black on old trunks, deeply and irregularly furrowed. Wood light, soft, easily worked, not liable to splinter, weak, not durable, light red-brown, with thick, nearly white sapwood.

Distribution in the State. At least the eastern half or two-thirds.

Habitat. Planted in various types of soil.

Remarks. Rapid growing and quite a little used to produce windbreaks, rows of tall slender trees or for special effects. Native of western Asia.

FIG. 147.—*Populus nigra italica.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ¾.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.

(From Otis: Michigan Trees.)

SALICACEÆ.

Populus canadensis Moench. (× *Populus eugenei* Hort. ex Dode).

Carolina Poplar (Hybrid).

Habit. Rapid growing, upright tree, with several strongly ascending branches; normally without suckers.

Leaves. Alternate, simple, up to about 17 cm. long, about as broad; mostly triangular-ovate, broadest at or below the middle; long acuminate; truncate or cuneat at the base; crenate-serrate, the teeth terminating in an incurved callous; smooth; shiny; dark green, becoming yellow in autumn; petioles 3-7 cm. long, slender, compressed laterally.

Flowers. April, before the leaves; diœcious, but only the staminate known, these in short-stalked, densely-flowered, pendulous catkins, 10-15 cm. long, emerging from long, pointed buds; stamens 30-40, with reddish anthers.

Fruit. Unknown.

Twigs in Winter. Slender, or but moderately stout, smooth, yellowish or yellowish-green; but moderately swollen at the nodes, if at all. Pith 5-angled, continuous. Terminal bud 1-2 cm. long, conical, acute, somewhat resinous, shining, yellowish or brownish; lateral buds similar, appressed, divergent or outwardly curved, those bearing embryonic leafy branches smaller than those bearing flower branches. Leaf scars broad; bundle scars 3; stipule scars present.

Bark and Wood. Similar to *Populus balsamifera.*

Distribution in the State. Freely planted nearly or quite throughout the state.

Habitat. Prefers rich, moist soil, but grows in a variety of situations.

Remarks. The Carolina Poplars are in need of extended taxonomic study. It is considered that this tree is a hybrid between *Populus nigra* and *P. balsamifera,* but there may be other origins for trees passing under the name, "Carolina Poplar." Also sold as Norway Poplar.

FIG. 148.—*Populus canadensis.*

1. Portion of winter twig, showing leaf buds, x 1.
2. Portion of winter twig, showing flower buds, x 1.
3. The commoner type of leaf, x ½.
4. Another leaf type and section of petiole, x ½.
5. Leaf margin, enlarged.
6. Portion of a twig with a staminate catkin partly expanded, x 1.
7. Staminate flower and its bract, enlarged.
8. Staminate flower, showing the insertion of the stamens, enlarged.

(Original.)

SALICACEÆ.

Populus balsamifera L. (*Populus deltoides* Marsh).

Eastern Cottonwood, Cottonwood.

Habit. A stately tree attaining a height of 20-30 meters (65-100 ft. and a trunk diameter of 1-2 meters or more; forming a spreading, open, symmetrical crown of massive, horizontal branches and stout, more or less angled branchlets.

Leaves. Alternate, simple, 7-13 cm. long, nearly as broad; broadly deltoid-ovate; coarsely crenate-serrate above the entire flat or heart-shaped base, teeth incurved; thick and firm; shiny dark green above, paler beneath; bright yellow in autumn; petioles 5-7 cm. long, slender, compressed laterally.

Flowers. April, before the leaves; diœcious; the staminate in short-stalked, densely-flowered reddish catkins 8-10 cm. long; the pistillate in short-stalked, few-flowered greenish catkins elongating to 15-20 cm.; calyx 0; corolla 0; stamens very numerous with red anthers; ovary stout, surrounded at the base by a cup-shaped disk; stigmas 3-4, spreading.

Fruit. May; 2-4-valved, short-stalked capsules, borne in drooping catkins 13-25 cm. long; seeds light brown, densely cottony.

Twigs in Winter. Stout, smooth, light yellowish-green, becoming grayish; often longitudinally ridged. Pith 5-angled, continuous. Terminal bud 1-2 cm. long, conical, acute, very resinous, shining, brownish or yellowish. Leaf scars broad; bundle scars 3; stipule scars present.

Bark and Wood. Young stems smooth, yellow-green; old trunks ashy gray, deeply divided into straight furrows, with broad, rounded ridges, broken into scales. Wood light, soft, weak, close-grained, dark brown, with thick, whitish sapwood; warps badly and is difficult to season.

Distribution in the State. Records do not distinguish between this and *Populus sargentii,* but probably only in the eastern third of the state.

Habitat. Prefers rich, moist soil; river banks; river bottoms; lake shores; grows well in drier situations.

Remarks. An important lumber tree and one frequently planted.

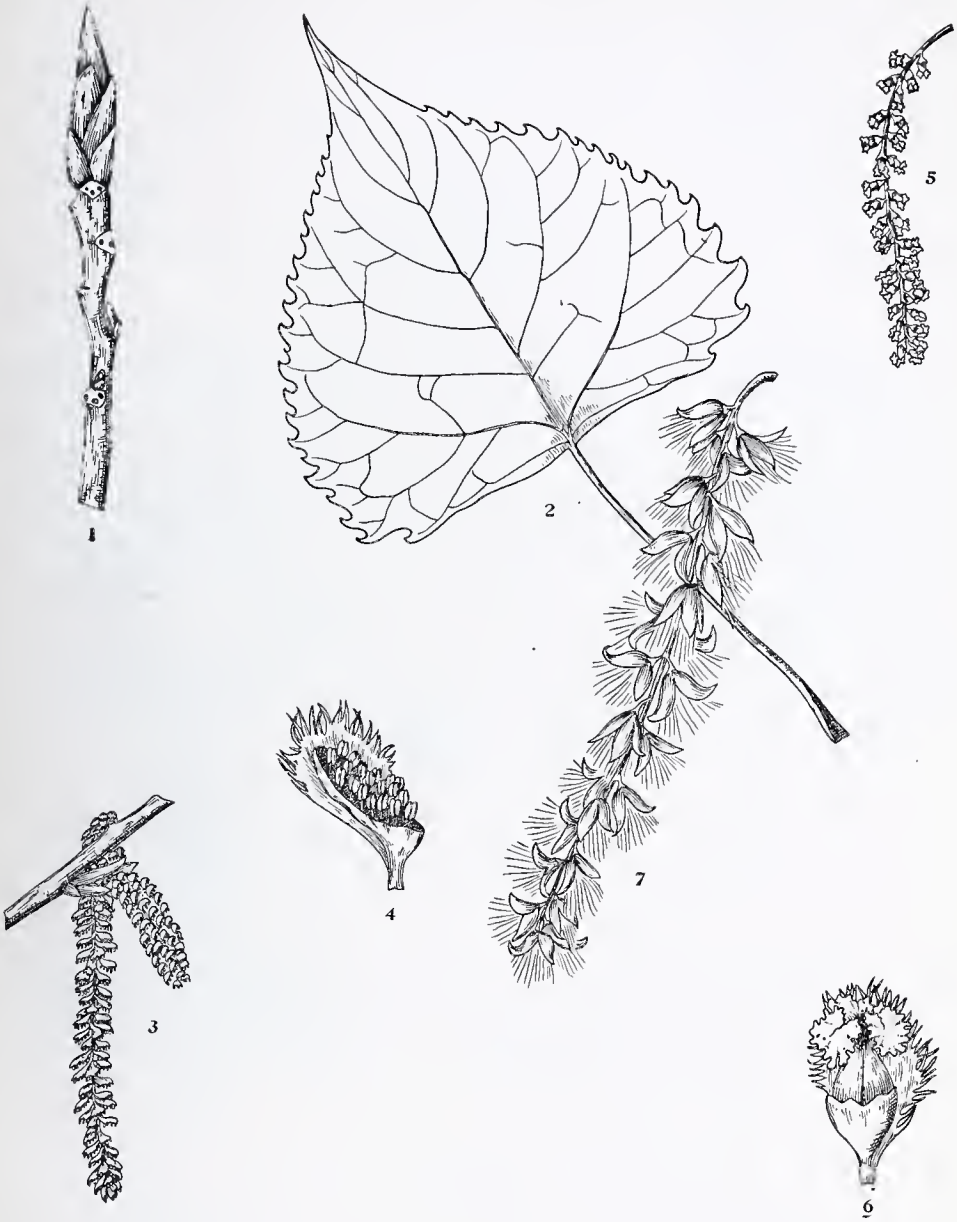

FIG. 149.—*Populus balsamifera.*

1. Winter twig, x 1.
2. Leaf, x ½.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate catkin, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

(From Otis: Michigan Trees.)

SALICACEÆ.

Populus sargentii Dode.

Plains Cottonwood.

Habit. A tall tree, up to about 28 meters (90 ft.) high, or usually smaller, forming a spreading, open, symmetrical crown of massive horizontal branches, and stout more or less angled branchlets and twigs.

Leaves. Similar to *Populus balsamifera.* Broadly triangular-ovate, often wider than long, subcordate to truncate at the base, rather long-acuminate at the apex, the margins coarsely and bluntly toothed (more so than *P. balsamifera*), glabrous on both sides when mature, but normally minutely ciliate between the teeth, petioles flattened, about as long as the blades.

Flowers. April, before the leaves, diœcious, staminate catkins 5-9 cm. long, not very dense, otherwise similar to *P. balsamifera.*

Fruit. May, ovoid capsules, 11-15 mm. long, 3-4 times longer than their pedicels, in catkins 12 cm. long or more; seeds light brown, densely cottony.

Twigs in Winter. Moderate, smooth, greenish to light yellow, buds usually pubescent, otherwise similar to *P. balsamifera.*

Bark and Wood. Bark thick and gray, similar to *P. balsamifera.*

Distribution in the State. Has usually been recorded as *P. balsamifera.* Probably the cottonwood of the western three-fourths of the state.

Habitat. Rich, moist soil, along watercourses, but will grow freely elsewhere if planted.

Remarks. An important lumber tree, although the wood is useful only as dimension stuff and for the manufacture of cheap packing boxes and crates, or pulp wood, or as fuel. A very large tree near Manhattan is 8.6 meters in circumference, with an E. W. diameter of 2.6 meters, but is a little exceeded in circumference by at least two others in the state.

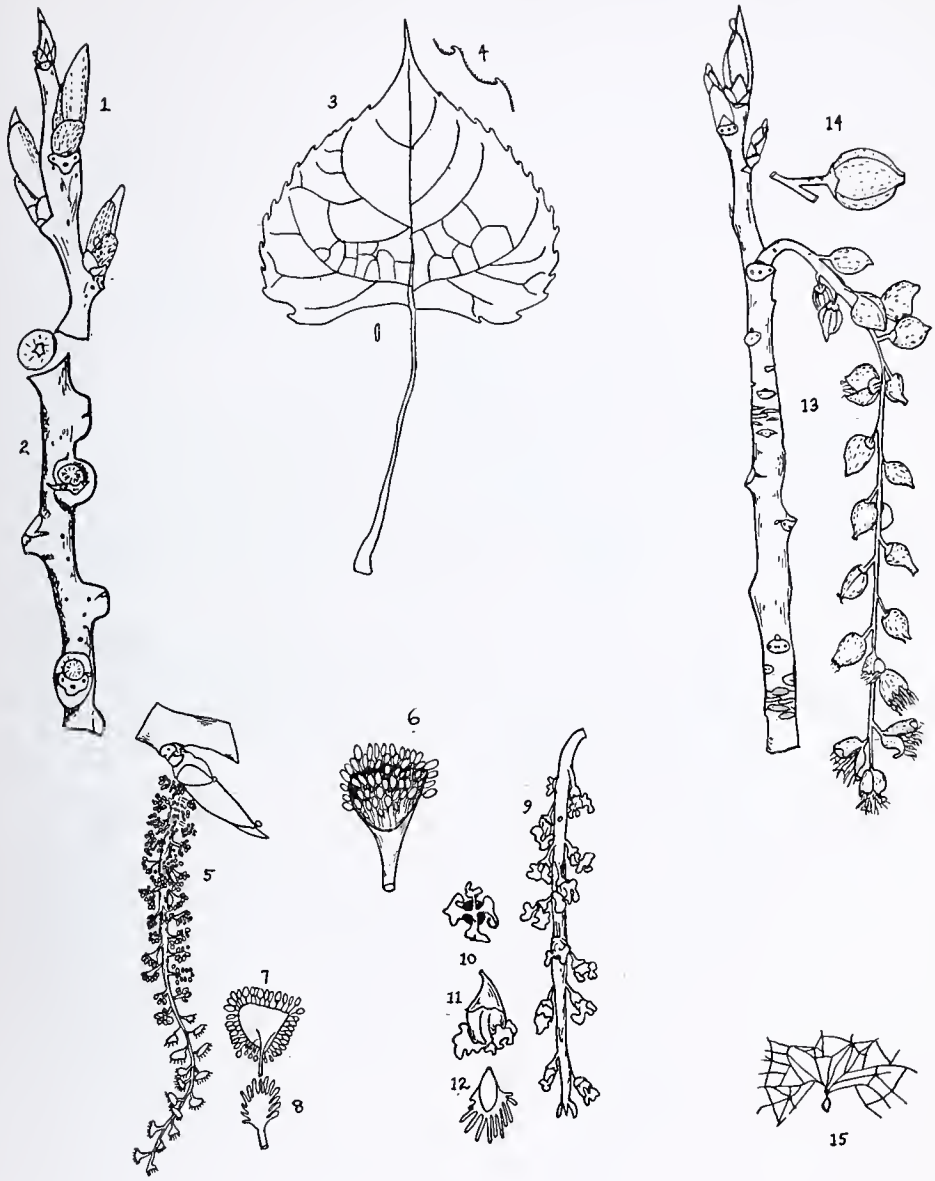

FIG. 150.—*Populus sargentii.*

1. Winter twig, x ½.
2. Three-year-old twig, showing conspicuous nodes, reduced.
3. Leaf, x ½.
4. Leaf margin, enlarged.
5. Staminate inflorescence, x ½.
6. Insertion of stamens.
7. Staminate flower from beneath, enlarged.
8. Scale of staminate flower, x 1.
9. Pistillate inflorescence, x ½.
10. Pistillate flower from above, x 1.
11. Pistillate flower from side, x 1½.
12. Scale of pistillate flower, x 1½.
13. Fruiting twig, x ½.
14. Fruit, x 1.
15. Seed, enlarged.

(Original.)

SAPOTACEÆ.

Bumelia lanuginosa (Michx.) Pers.

Gum Elastic, Woolly Buckthorn.

Habit. A shrub or tree, as high as 18 meters (60 ft.) and a trunk diameter of 1 meter, but smaller than either of these in Kansas. The twigs usually spiny; when young, quite straight and slender; when old, gnarled and rugged.

Leaves. Alternate; usually persistent; rather coriaceous; glabrous above, densely rusty-wooly on the under side; oblanceolate, obovate or oblong; usually obtuse at the apex narrowed or cuneate at the base; 4-8 cm. long, less than ⅓ as wide; petioles 4-13 mm. long.

Flowers. June-July, small (3 mm. broad), whitish or greenish; 3-18 in fascicles in the axils; pedicels tomentose, longer than the petioles; calyx deeply 5-parted, the segments ovate, imbricated, unequal, tomentose, obtusish; corolla 5-lobed, with a pair of lobelike appendages at each sinus; its tube short; stamens 5, staminodia 5, alternate with the stamens, petaloid, ovate, obscurely toothed; ovary 5-celled, style filiform.

Fruit. Berry, oval or globose, black, 8-11 mm. long, inclosing a single erect shining seed; remaining on until winter.

Twigs in Winter. Moderate, zigzag. Pith continuous, white or striped with brown. Buds small, hemispherical, sessile, sometimes branched or developing a spine, with about 4 exposed scales. Leaf scars crescent-shaped, somewhat raised; bundle scars 3, running together.

Bark and Wood. When young a hard grayish bark, changing to a rough black bark; wood soft, weak, yellowish-brown.

Distribution in the State. The southeastern half dozen counties.

Habitat. Woods and thickets.

Remarks. At its northwestern limit in southeastern Kansas.

FIG. 151.—*Bumelia lanuginosa.*

1. Winter twig, x 1.
2. Portions of twigs, showing buds and leaf scars, enlarged.
3. Portion of twig, showing spines with leaves, reduced.
4. Portion of flowering twig, showing leaves, x ½.
5. Portion of the fruiting branch, x ½.
6. Fruit cut to show seed, x 1.

(Original.)

EBENACEÆ.

Diospyros virginiana L.

Persimmon.

Habit. Tree, under 9 meters (30 ft.) in height, but sometimes 30 cm. or more in diameter.

Leaves. Alternate; simple; ovate or oval; pubescent when young, becoming glabrous; acute or acuminate; narrowed, rounded or subcordate at the base; dark green above, pale beneath; 5-13 cm. long; petioles 6-21 mm. long, loosely attached to the twigs.

Flowers. May; with or after the leaves, polygamo-diœcious, the pistillate solitary, the staminate clustered in the axils; calyx 4-6 cleft, enlarging in fruit; corolla 4-6 lobed, greenish-yellow, that of the fertile flowers 11-15 mm. long, about twice as large as that of the sterile; stamens of the sterile flowers about 16, those of the pistillate 8 or fewer.

Fruit. October, globose, about 2.5 cm. long, reddish-yellow and sweet when ripe, astringent while green.

Twigs in Winter. Moderate, terete, somewhat zigzag, red brown, finally with evident lenticels. Pith rounded, greenish becoming white, sometimes becoming spongy or even chambered between lacelike plates. Buds solitary, sessile, triangular, with 2 greatly overlapping scales, the terminal bud absent. Leaf scars 2-ranked on horizontal branches, others varying, roundish; bundle scar 1, C-shaped; stipule scars lacking.

Bark and Wood. Bark hard, dark and furrowed. Wood white or black at the heart, fine-grained, heavy.

Distribution in the State. Eastern third, but particularly the southern half of this third.

Habitat. Uplands in good soil.

Remarks. Cultivated for the edible fruit.

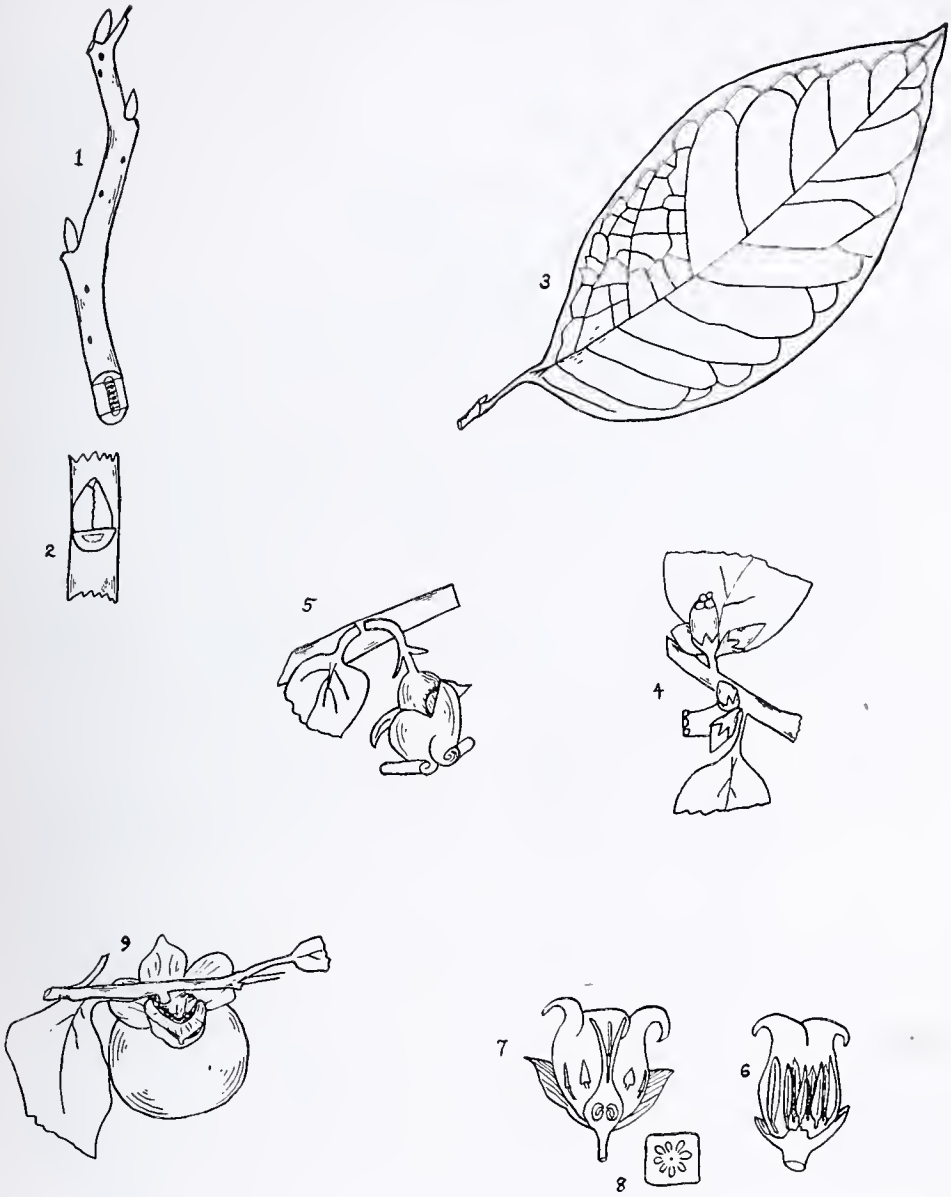

FIG. 152.—*Diospyros virginiana.*

1. Winter twig from above, x 1.
2. Winter twig from side, x 2.
3. Leaf, x ½.
4. Portion of flowering branch of a staminate tree, slightly enlarged.
5. Portion of flowering branch of a pistillate tree.
6. Section of a staminate flower, enlarged.
7. Section of a pistillate flower, enlarged.
8. Cross-section of pistil, showing ovules, enlarged.
9. Fruiting branch, x ½.

(1-3, 9, original; 4-8, redrawn from Sargent.)

OLEACEÆ.

Fraxinus americana L.

White Ash.

Habit. A large tree 15-20 meters (50-65 ft.) high, with a trunk diameter of under 60 cm.; forming an open pyramidal crown of long, slender, lateral branches and a stout, rather sparse spray.

Leaves. Opposite, pinnately compound, 20-30 cm. long. Leaflets usually 7-9, 7-13 cm. long, 2.5 to 5 cm. broad; short-stalked; ovate to oblong-lanceolate; entire or obscurely serrate; thick and firm; glabrous, dark green above, paler beneath. Petioles glabrous, stout, grooved.

Flowers. May, before the leaves; diœcious; borne in loose panicles on shoots of the previous season; calyx campanulate, 4-lobed; corolla 0; stamens 2, rarely 3; ovary 2-celled.

Fruit. August-September; persistent on the branches until midwinter or the following spring; samaras 2.5 to 5 cm. long; a broad flattened wing about 6 mm. wide attached near the tip of the elongated seed; in crowded, drooping, paniculate clusters 15-20 cm. long.

Twigs in Winter. Moderately stout, at first dark green, becoming gray or light brown, often covered with a glaucous bloom. Pith roundish, somewhat flattened in section, continuous, white. Buds sessile, short, superposed with the lower somewhat covered by a narrow articular membrane, with 3 or 4 pairs of opposite rusty-brown scales acute and keeled in the back. Leaf scars broadly U-shaped; bundle scars in a C-shaped aggregate; stipule scars lacking.

Bark and Wood. Bark gray, deeply furrowed into firm, narrow, flattened ridges on the trunk. Wood heavy, hard, strong, close-grained, tough, brown, with thick, lighter colored sapwood.

Distribution in the State. Eastern fourth, extending farther west in southern part of the state.

Habitat. Prefers a rich, moist, loamy soil, but grows in any well-drained situation; common along stream beds.

Remarks. A desirable ornamental and useful tree, but not as frequently used in Kansas as others of the same genus.

FIG. 153.—*Fraxinus americana.*

1. Winter twig, x 1.
2. Leaf, x ¼.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

(From Otis: Michigan Trees.)

OLEACEÆ.

Fraxinus pennsylvanica Marsh.

Red Ash.

Habit. A medium-sized tree 9-18 meters (30-60 ft.) high, with a trunk diameter of 30-60 cm.; stout, upright branches and slender branchlets form a compact, broad, irregular crown.

Leaves. Opposite, pinnately compound, 25-30 cm. long. Leaflets, 7-9, 5-10 cm. long, 2.5 to 4 cm. broad; short-stalked; oblong-lanceolate to ovate; slightly serrate or entire; thin and firm; glabrous, yellow-green above, pale and silky-downy beneath. Petioles stout, pubescent.

Flowers. May, with the leaves; diœcious; borne in compact, downy panicles on shoots of the previous season; calyx cup-shaped, 4-toothed; corolla 0; stamens 2, rarely 3; ovary 2-celled.

Fruit. Early autumn, persistent on the branches throughout the winter; samaras 2.5 to 5 cm. long, the flat wing extending part way down the seed, in open, paniculate clusters.

Twigs in Winter. Moderately stout, cylindrical; pale pubescent at first, lasting 2-3 years or often disappearing during the first summer, finally ashy gray or brownish and often covered with a glaucous bloom. Pith roundish, white, continuous. Buds small, rounded; bud-scales rounded on the back, 3 pairs, rusty brown, tomentose. Leaf scars broad; bundle scars many in a flattened ring; stipule scars absent.

Bark and Wood. Bark brown or dark gray on the trunk, with many longitudinal, shallow furrows; somewhat scaly. Wood heavy, hard, strong, brittle, coarse-grained, light brown, with thick, yellow-streaked sapwood.

Distribution in the State. Scattering in the central portion of the state east and west, but more records from the northern portion of this area.

Habitat. Wet or moist, rich loam; river banks; swampy lowlands.

Remarks. Has been planted on timber claims. The inner face of the outer bark of branches is reddish when fresh.

Fraxinus campestris Britton, with the lateral leaflets broader and sessile and the fruit shorter, is a similar tree of the western plains, ranging eastward into Kansas.

FIG. 154.—*Fraxinus pennsylvanica.*

1. Winter twig, x 1.
2. Leaf, x ⅓.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

(From Otis: Michigan Trees.)

OLEACEÆ.

Fraxinus lanceolata Borkh.

(*Fraxinus pennsylvanica lanceolata* [Borkh.] Sarg.)

Green Ash.

Habit. A tree up to 18 meters (60 ft.) high and with trunk diameter up to 60 cm. Branches stout, upright, forming with the slender branchlets a compact, broad, irregular crown.

Leaves. Opposite, pinnately compound, 25-30 cm. long. Leaflets 7-9, 5-10 cm. long, 2-3 cm. broad, short-stalked, oblong-lanceolate to ovate, slightly serrate, seldom entire, thin and firm, glabrous, bright green on both sides. Petioles stout, glabrous, more or less grooved.

Flowers. Essentially as in *Fraxinus pennsylvanica.*

Fruit. Essentially as in *Fraxinus pennsylvanica,* but infrequently the wings may be 3-sided rather than flat.

Twigs in Winter. Moderate, ashy-gray or yellowish-brown, glabrous. Pith roundish, white, continuous. Buds small, stout, opposite, flattish; scales rusty-brown, hairy. Leaf scars shield-shaped, with upper margin flat across or but slightly indented for the axillary bud; bundle scars many in a flattened ring.

Bark and Wood. Bark brownish or gray on the old branches or main trunk, divided into shallow longitudinal furrows and ridges which often become more or less scaly in age. The inner surface of the fresh bark is straw colored or yellowish-brown. Wood heavy, hard, strong, coarse-grained, easy to split, light brown, with thick greenish sapwood; quite durable in contact with the soil.

Distribution in the State. Virtually throughout, but limited to stream courses in the western part.

Habitat. Prefers moist, well-drained, loamy soil of woodlands and river bottoms, but grows in much drier situations.

Remarks. One of the most wide-spread trees in the state. The trunks may become infested with borers.

FIG. 155.—*Fraxinus lanceolata.*

1. Winter twig, x 1.
2. Leaf, x ⅓.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

(From Otis: Michigan Trees.)

OLEACEÆ.

Fraxinus quadrangulata Michx.

Blue Ash.

Habit. A tree under 10 meters (33 ft.) high, with a trunk diameter of 30 cm. or less; small, spreading branches and stout, 4-angled, more or less 4-winged branchlets form a narrow crown.

Leaves. Opposite, pinnately compound, 20-30 cm. long. Leaflets 5-9, usually 7, 7-13 cm. long, 2.5 to 5 cm. broad; short-stalked; ovate-oblong to lanceolate, long-pointed; coarsely serrate; thick and firm; yellow-green above, paler beneath, glabrous. Petioles slender, glabrous.

Flowers. April, before the leaves; perfect; borne in loose panicles on shoots of the previous season; calyx reduced to a ring; corolla 0; stamens 2; ovary 2-celled.

Fruit. September-October, falling soon after; samaras 2.5 to 5 cm. long, 6-15 mm. wide, winged all around, parallel-nerved, the body extending more than half way to the apex, which is often notched, in long, loose, paniculate clusters.

Twigs in Winter. Moderately stout, 4-angled, brownish or grayish. Pith roundish, white, continuous. Buds short, rather obtuse; bud scales rounded on the back, 3 pairs, dark red-brown, somewhat pubescent. Leaf scars broad, approaching half-moon shape; bundle scars in a C-shaped row; no stipule scars.

Bark and Wood. Bark on the trunk light gray tinged with red, irregularly divided into large, platelike scales, often with the shaggy appearance of a Shagbark Hickory. Wood heavy, hard, close-grained, brittle, light yellow streaked with brown, with thick, light yellow sapwood.

Distribution in the State. The southeastern half dozen counties.

Habitat. Prefers rich, limestone hills, but grows well in fertile bottom lands.

Remarks. A valuable timber tree further southeast. The inner bark colors water blue, whence the name.

FIG. 156.—*Fraxinus quadrangulata.*

1. Winter twig, x 1.
2. Leaf, x ½.
3. Flowering branchlet, x 1.
4. Flower, enlarged.
5. Fruit, x ½.

(From Otis: Michigan Trees.)

OLEACEÆ.

Forestiera acuminata (Michx.) Poir.

Swamp Privet, Forestiera, Adelia.

Habit. A shrub or small tree, not over 4.5 meters (15 ft.) high in this state, the branches somewhat spiny.

Leaves. Opposite, simple, ovate, lanceolate or oblong, acuminate or acute at both ends, finely toothed, 2.5 to 10 cm. long, 1-5 cm. wide, glabrous. Petioles slender, 8-25 mm. long.

Flowers. April, with or before the leaves, small, yellowish or greenish, diœcious or polygamous; staminate fascicled and pistillate short-paniculate in the axils; calyx obsolete, corolla 0 or of 1-2 deciduous petals; stamens 2-4; ovary ovoid, 2-celled.

Fruit. A narrowly oblong drupe, black, about 12 mm. long.

Twigs in Winter. Slender, many, short, divergent, almost spiny, round, glabrous or puberulent, warty. Pith small, continuous, white, rounded. Buds superposed, sessile, globose, small, with 2-4 pairs of exposed scales. Leaf scars opposite, shield-shaped, low and small; bundle scar 1, crescent-shaped; stipule scars absent.

Bark and Wood. Bark light gray. Wood heavy, soft, weak, yellowish-brown.

Distribution in the State. Recorded from Cherokee and Labette counties in the extreme southeastern part of the state, but planted elsewhere.

Habitat. Rich bottom lands, stream banks.

Remarks. As seen in cultivation usually an arching bush, widely spreading from the dense clump of stems in the center.

Chionanthus virginica L., the Fringetree, a small oleaceous tree with long narrow petals (25 x 2 mm.), native further east, is sometimes planted.

FIG. 157.—*Forestiera acuminata.*

1. Winter twig, x 1.
2. Portion of winter twig, showing superposed buds, enlarged.
3. Leaf, x 1.
4. Flowering twig with staminate flower cluster.
5. Single staminate flower cluster, enlarged.
6. Staminate flowers, enlarged.
7. Portion of a flowering twig, showing pistillate inflorescence.
8. Pistillate inflorescence, enlarged.
9. Fruit, x 1.

(Original.)

SCROPHULARIACEÆ.

Paulownia tomentosa (Thunb.) Steud.

Paulownia.

Habit. A tree, but appearing somewhat bushy here due to winter killing, and trimming. Branches stout, spreading.

Leaves. Opposite, simple, broadly cordate-ovate, 15-40 cm. by 10-20 cm., entire or 3-lobed, long-petioled, pubescent above, tomentose beneath, glabrate above when old.

Flowers. Before or during leaving; 5 cm. or more long; numerous in large erect terminal panicles produced the preceding autumn; pedicels stout, densely tomentose; calyx deeply 5-cleft, the lobes short, thick, tomentose; corolla tube elongated, enlarged above; lobes 5, spreading obliquely, somewhat unequal, pale violet; stamens 4; style slender, stigmatic along the inner face.

Fruit. Woody capsule 5 x 2.5 cm. opening by 2 valves. Seeds numerous, small, winged.

Twigs in Winter. Stout, light brown, resembling Catalpa, compressed at the nodes. Pith large, white, soon chambered or hollowed out between the nodes. Terminal bud lacking; lateral buds superposed, sessile, half-round, with about 4 exposed blunt scales. Leaf scars opposite, subelliptical, more or less notched at the top, raised; bundle scars many, in a nearly closed ring; stipule scars lacking.

Bark and Wood. Thin flaky bark.

Distribution in the State. Native of Japan; planted occasionally.

Habitat. Good soil.

Remarks. Producing a bold effect with its large leaves. Considered to hold the record for maximum longitudinal growth in a growing season among trees in the temperate zone—21.5 feet (6.56 meters)—sprouts from a beheaded tree (W. F. Prouty, Science 54:170).

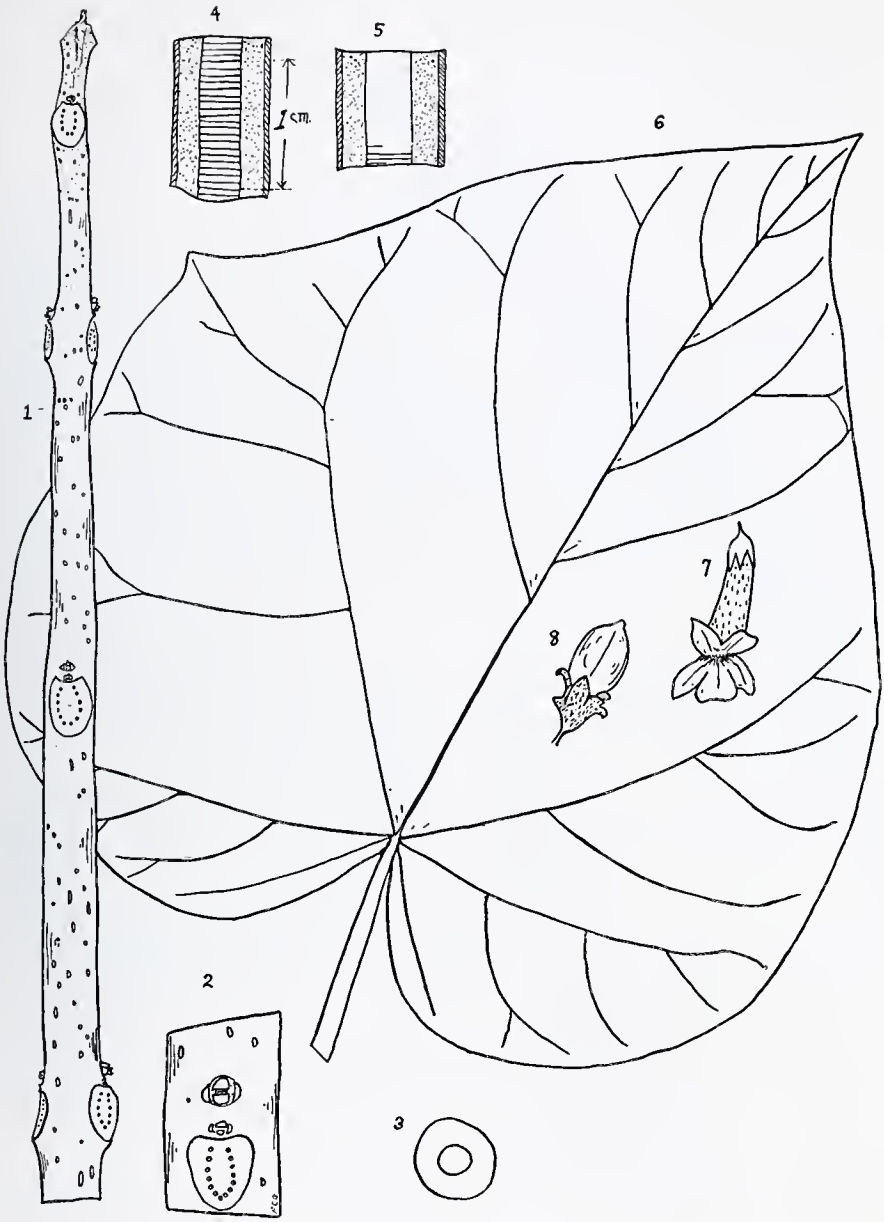

FIG. 158.—*Paulownia tomentosa.*

1. Winter twig, x 1.
2. Portion of winter twig, enlarged.
3. Section of twig, showing shape of pith, x 1.
4. Section of young twig, showing chambers in the pith, x ½.
5. Section of an older twig, showing partial disappearance of partitions, x 1.
6. Leaf, x ¼.
7. Flower, x ¼. (Redrawn from Britton and Brown.)
8. Fruit, x ¼. (Redrawn from Britton and Brown.)

(Original.)

BIGNONIACEÆ.

Catalpa speciosa Warder.

Hardy Catalpa.

Habit. A tree 9-12 meters (30-40 ft.) high, with a short, often crooked tapering trunk and a broad, rounded crown of slender, spreading branches and thick branchlets and twigs.

Leaves. Opposite or whorled, simple, 10-25 cm. long, 8-20 cm. broad; heart-shaped; entire or sometimes slightly lobed; thick and firm; glabrous, dark green above, downy beneath, turning dark brown or black and falling with the first severe frost; petioles long, stout, terete.

Flowers. June-July, after the leaves are full grown; perfect; borne on slender, purplish pedicels in open, few-flowered panicles 13-15 cm. long; calyx 2-lobed, purple; corolla white with 2 yellow stripes inside and purplish-brown spots, campanulate, 5-lobed, 5-6 cm. broad; stamens 2, staminodia 3; ovary 2-celled.

Fruit. Ripens in early autumn; slender, 2-celled, cylindrical capsule 15-40 cm. long and 12-20 mm. thick; hangs on tree all winter, opening in spring before falling, or shedding its seeds during the winter; seeds light brown, about 25 x 6 mm., with rounded, wide-fringed wings at each end.

Twigs in Winter. Stout, round, orange or reddish-brown. Pith large, round, continuous, pale. Terminal bud absent; lateral buds solitary, sessile, globose, with about 6 loose, pointed scales. Leaf scars whorled, alternating two large and one small and two small and one large, round-elliptical, raised; bundle scars a dozen or so in an ellipse; stipule scar lacking.

Bark and Wood. Bark greenish, often with purple tinge, becoming orange or red-brown and covered with a slight bloom the first winter, darker with age and thick, red-brown, broken into thick scales on the trunk. Wood light, soft, weak, coarse-grained, light brown, with very thin, almost white sapwood; very durable in contact with the soil.

Distribution in the State. A native further east, but quite frequently planted and does very well if in soil with sufficient moisture; most satisfactory in the eastern part.

Habitat. Moist, low but well-drained areas.

Remark. A prized ornamental tree, and one of the best to plant for fence posts and similar uses.

FIG. 159.—*Catalpa speciosa.*

1. Winter twig, x 1.
2. Leaf, x ¼.
3. Panicle of flowers, x ⅜.
4. Fruit, x ½.
5. Seed, x 1.

(From Otis: Michigan Trees.)

BIGNONIACEÆ.

Catalpa catalpa (L.) Karst (*C. bignonioides* Walt.).

Common Catalpa.

Habit. A tree 8-12 meters (25-40 ft.) high, with a short, thick trunk and a broad, irregular crown of long, crooked branches, and coarse branchlets and twigs.

Leaves. Whorled or opposite, simple, 8-20 cm. long, 5-15 cm. broad; heart-shaped; entire or sometimes slightly lobed; thin and firm; glabrous, light green above, downy beneath, turning black and falling with the first severe frost; petioles long, stout, terete.

Flowers. June-July, after the leaves are full grown; perfect; borne on slender, hairy pedicels in compact, many-flowered panicles 15-25 cm. long; calyx 2-lobed, green or purple; corolla white with 2 yellow stripes inside and purplish brown spots, campanulate, 5-lobed, irregular, 4-5 cm. broad; stamens 2, staminodia 3; ovary 2-celled.

Fruit. Ripens in early autumn; slender, 2-celled, cylindrical capsule 15-40 cm. long and about 6 mm. thick; hangs on tree all winter, opening in spring before falling; seeds silvery gray, 2.5 cm. long, with pointed, fringed wings at each end.

Twigs in Winter. Stout, round, orange or reddish brown. Pith large, round, continuous, pale. Terminal bud absent; lateral buds solitary, sessile, globose, with about 6 loose, pointed scales. Leaf scars whorled, some larger than others, round-elliptical, raised; bundle scars a dozen or so in an ellipse; stipule scars lacking.

Bark and Wood. Bark greenish purple, becoming red-brown and marked by a network of thin, flat ridges, thin, red-brown on the trunk, separating into large, thin, irregular scales. Wood light, soft, weak, coarse-grained, light brown, with very thin, whitish sapwood; very durable in contact with the soil.

Distribution in the State. Much the same status as for *Catalpa speciosa.*

Habitat. Moist, low, well-drained areas.

Remarks. Similar to but not so satisfactory as *Catalpa speciosa.* One variety forms a dense, broad bush.

Catalpa ovata Don., a cultivated species differing in having the flowers yellow, inside striped orange and spotted dark violet, and less than 2.5 cm. in length, with pods about 30 x 0.8 cm. may occur in cultivation.

FIG. 160.—*Catalpa catalpa.*

1. Winter twig, x 1.
2. Leaf, x ⅜.
3. Panicle of flowers, x ⅓.
4. Fruit, x ½.
5. Seed, x 1.

(From Otis: Michigan Trees.)

MALACEÆ.

Amelanchier canadensis (L.) Medic.

Service Berry, Shadbush, Juneberry.

Habit. A small tree 6-9 meters (20-30 ft.) in height, with a smooth trunk 8-25 cm. in diameter; forming a very narrow, rounded crown of many small limbs and slender branchlets.

Leaves. Alternate, simple, 5-8 cm. long and about one-half as broad; ovate to obovate; finely and sharply serrate; abruptly pointed; glabrous, dark green above, paler beneath; petioles slender, 1 to 2.5 cm. long.

Flowers. April, when the leaves are about one-third grown; perfect; large, white, borne in drooping racemes 8-13 cm. long; calyx 5-cleft, campanulate, villous on the inner surface; petals 5, strap-shaped, white about 1 inch in length; stamens numerous; styles 5, united towards the base.

Fruit. June-August; globular, berry-like pome, 6-8 mm. long; turning from bright red to dark purple with slight bloom; sweet and edible when ripe.

Twigs in Winter. Twigs slender, zigzag, nearly terete. Pith somewhat 5-sided, pale, continuous. Buds yellow-brown, narrowly conical, 6-12 mm. long, several scales, sometimes twisted, slightly pubescent. Leaf scars narrowly crescent- or U-shaped; bundle scars 3; stipules lacking.

Bark and Wood. Smooth, light green, becoming red-brown, thin, pale red-brown on the trunk or gray, smoothish or divided by shallow fissures into narrow, longitudinal, scaly ridges. Wood heavy, very hard, strong, close-grained, dark red-brown, with thick, lighter colored sapwood.

Distribution in the State. Eastern tier of counties.

Habitat. Along river and creek banks; seldom found except on high cool banks fronting the north, in abundant moisture and shade.

Remarks. Highly ornamental when in flower, and the fruits much relished by birds and other animals.

FIG. 161.—*Amelanchier canadensis.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Flowering branchlet, x ½.
5. Vertical section of flower, enlarged.
6. Fruiting branchlet, x ½.

(From Otis: Michigan Trees.)

MALACEÆ.

Malus ioensis (Wood) Britton.

Iowa Crab Apple, Prairie Crab Apple.

Habit. Small tree, under 9 meters (30 ft.) high; trunk diameter 25-30 cm., but frequently a low, gnarly shrub. The spreading branches form a rounded crown; the lateral branches spurs or coarse spines.

Leaves. Alternate, simple, ovate or oblong, acute or rounded at the apex and the base, 8-12 cm. long and half as broad, sharply and deeply serrate and sometimes lobed, hoary-hairy when they unfold, but becoming thick and firm, dark green, shining and nearly smooth above, pale yellowish green and finely pubescent beneath, turning yellow in autumn before they fall; petioles stout, more or less hairy, especially at first, 2.5 to 4 cm. long.

Flowers. May, when the leaves are about full grown, 4-5 cm. wide when fully open, on slender hairy pedicels about 2.5 cm. long, or in few-flowered clusters; calyx urn-shaped, coated with thick snowwhite hairs, sepals 5, greenish, hairy on the inner surface; petals 5, inserted on the edge of the calyx tube, white or bright pink, obovate, very fragrant; stamens many, on the calyx margin; styles 5, slender, ovary hairy.

Fruit. October, greenish-yellow, fragrant, but bitter apple, 2.5 to 4 cm. in diameter, borne on stout, more or less hairy stalks about 2.5 cm. long, edible when cooked.

Twigs in Winter. Twigs moderate, rounded, occasionally ending in spines, at first white-hairy, and usually remaining somewhat woolly for a year, reddish-brown, pale specked. Pith somewhat angular, continuous. Buds moderate, solitary, sessile, with about 3 scales, more or less keeled above, the end bud sometimes lacking. Leaf scars somewhat raised, shallowly U-shaped; bundle scars 3; stipule scars lacking.

Bark and Wood. Bark becoming about 8 mm. thick, and breaking into long narrow persistent reddish-brown scales, and becoming more or less deeply fissured. Wood heavy, soft, close-grained, weak, reddish-brown, with thick yellowish or light brown sapwood.

Distribution in the State. In the northeastern and southeastern counties and along the Kansas river at least as far as Manhattan.

Habitat. Stony hillsides mostly along streams.

Remarks. *Malus coronaria* (L.) Mill., a crab apple, quite similar, but differing in that the leaves are quite glabrous when mature, as are also the twigs, is said to occur in "Kan." *Malus malus* (L.) Britton, the apple, differing in having the leaves rounded or subcordate at the base and a pome of over twice the diameter, is extensively cultivated and may occasionally be seen escaped, as also *Pyrus communis* L., the pear.

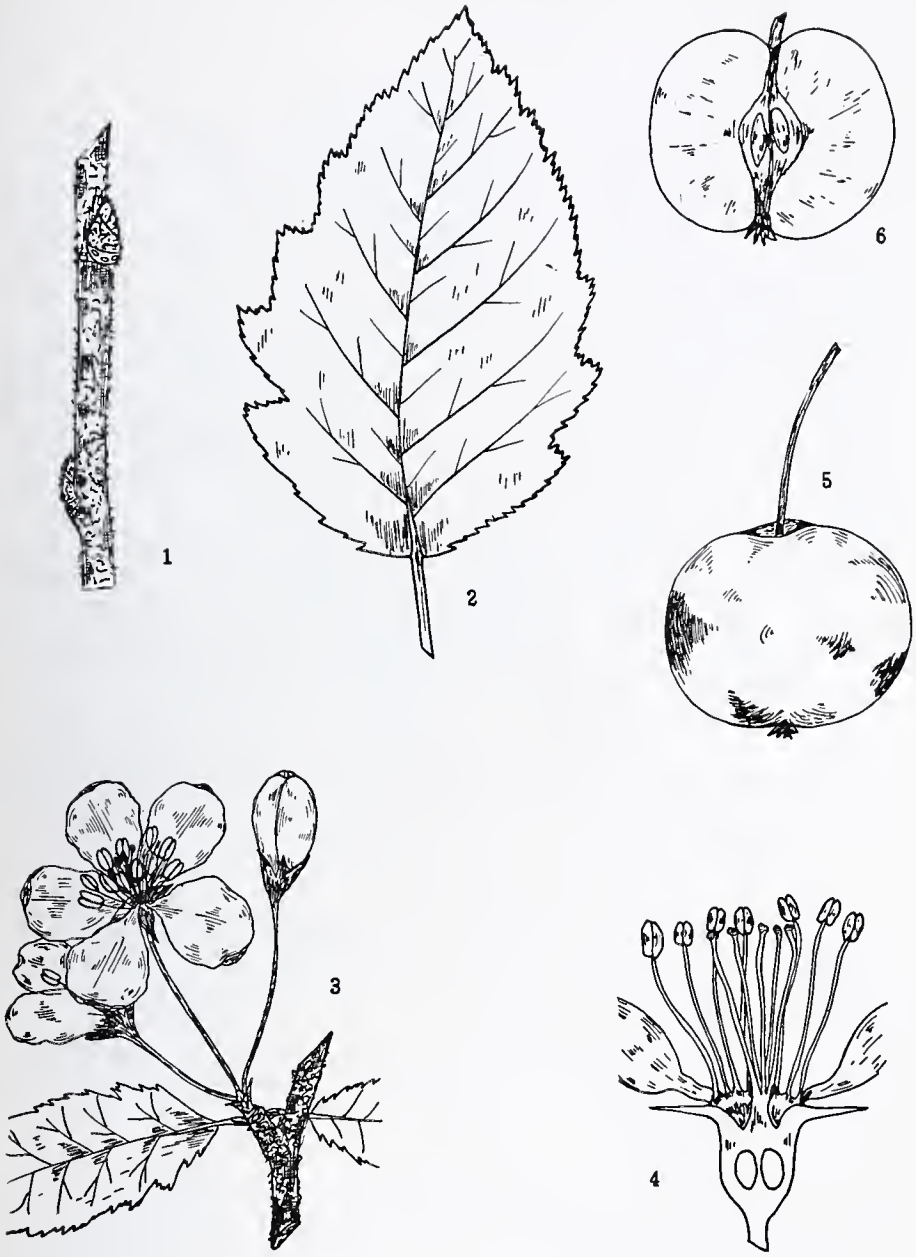

FIG. 162.—*Malus ioensis.*

1. Winter twig, x 1.
2. Leaf, x ¾.
3. Flowering branchlet, x ¾.
4. Vertical section of flower, enlarged.
5. Mature fruit, x 1.
6. Vertical section of fruit, x 1.

(From Pool: Nebraska Trees.)

MALACEÆ.

Cratægus.

Thorn Apple.

The genus Cratægus is a very large group of shrubs and trees, for the most part scattered over eastern United States, although a few of them occur in the extreme west. They are called by a large number of names of which Hawthorn, Red Haw, and Thorn Apples are perhaps more common. In view of the great complexity of the forms, together with their great variation both in different seasons and in different parts of the same plant, together with the uncertainty of the nomenclature, it is deemed inadvisable to do more here than give a general description, together with a picture of one.

The Hawthorns are usually low, wide-spreading, bushy shrubs or small, round-topped or bushy trees, seldom reaching a height exceeding 8-10 meters (26-33 ft.), and a trunk diameter of 45 cm., usually much smaller than these dimensions would indicate. The branches are strong, tough, often tortuous and more or less zigzag and armed with stiff, sharp-pointed thorns. The bark is usually more or less scaly or shredded, and varies from dark red to brown and gray and is commonly shallowly fissured.

The winter-buds are small, globose or nearly so, and covered by numerous, overlapping scales which are commonly bright chestnut-brown in color and shining.

The leaves are alternate, simple, generally serrate, often lobed, sometimes deeply lobed, with short or long petioles, and with many variations in shape, smooth and shining or more or less dull and hairy, more or less leathery and tough or thin and membranous, deciduous.

The flowers are white, and they appear in May or June, with or after the leaves, and are often produced in great profusion, in simple or compound, few- to many-flowered clusters on short lateral, leafy twigs; calyx tubular or bell-shaped, 5-lobed, the lobes acute or acuminate, green or reddish; petals 5, white or faintly pink; stamens many, on the edge of the calyx cup, with a rather definite arrangement and color for the different species, varying in color from pale yellow to nearly white, pink, light or dark rose-color or purple.

The fruit is globular, ovate, short-oblong or pear-shaped, scarlet, orange-color, red, yellow, blue, or black, resembling in all cases small to tiny apples, flesh usually dry and mealy, frequently sweet and edible.

The wood of the larger haws is heavy, hard, tough, close-grained, reddish-brown, with thick, usually pale sapwood; used for tool handles, mallets, walking sticks, other small articles and fuel.

Several of the species are valuable for hedges and other ornamental purposes. The beautiful and abundant flowers and brilliantly colored fruits make certain species quite desirable for planting in lawns and parks and several such forms are used in those places.

The Thorn Apples that were reported for Kansas previous to the special activity in studying the group are as follows: *Cratægus viridis* L., *Cratægus coccinea* L., *Cratægus crusgalli* L., and *Cratægus tomentosa* L. These are found particularly in woods along the rivers, for the most part in extreme southeastern Kansas, but in at least one case extending through the eastern fourth of the state. Those credited to Kansas in Sudworth's "Check List" are: In the southeastern part of the state, *Cratægus palmeri* Sarg. and *C. viridis* L.; and in the eastern part, *C. mollis* (T. & G.) Scheele, *C. coccinioides* Ashe, and *C. tomentosa* L.

FIG. 163.—*Cratægus.*

1. Winter twig, x 1.
2. Leaf, x 1.

Center below. Flowering branchlet, x ½.

Center above. Vertical section of flower, enlarged.

5. Fruit, x 1.

(From Otis: Michigan Trees.)

PRUNACEÆ.

Prunus americana Marsh.

Wild Plum.

Habit. Often a small, gnarly tree in dense thickets formed by sprouting from the roots, but occasionally in the eastern counties a small tree up to 10 meters (33 ft.) high and trunk diameter of 20-30 cm.; thorny.

Leaves. Alternate, simple, oval or sometimes obovate, acuminate, even when they first unfold, narrowed and often rounded at the base, sharply and often doubly serrate, thick and firm, dark green above, pale and glabrous or more or less hairy beneath, 6-10 cm. long, about 4 cm. wide; petioles slender, 7-16 mm. long, usually without glands.

Flowers. April, with or before the leaves, about 2.5 cm. in diameter, fragrant, on slender, smooth or hairy, green pedicels 8-16 mm. long in 2-5-flowered clusters; calyx 5-lobed, light red, smooth, green and pubescent inside, lobes entire acute; petals 5 white, rounded or slightly cut at the apex; stamens 15-20; ovary club-shaped, greenish.

Fruit. August-October, globose plum, usually less than 2.5 cm. in diameter, green turning to orange or red. Skin thick, tough, acrid; flesh bright yellow, acid, sweet, juicy, edible; stone oval, pointed at the apex, often as thick as broad, sometimes distinctly flattened, ridged or grooved on the edge.

Twigs in Winter. Twigs slender, subterete, often spine-tipped, smooth or more or less hairy, light orange-brown, becoming tinged with reds or purples. Pith roundish, continuous. Terminal bud lacking, lateral buds sessile, ovoid, acute, 3-6 mm. long, chestnut-brown. Leaf scars raised on a cushion flanked by the stipule scars or vestiges, half-elliptical, small; bundle scars 3, usually minute. Many more or less spiny lateral branchlets.

Bark and Wood. Bark on main trunk about 12 mm. thick, dark brown tinged with red, separating at the surface into large thin, scaly, persistent plates. Wood hard, heavy, close-grained, strong, dark brown tinged with red, with thin, lighter-colored sapwood.

Distribution in the State. Absent only from the southwestern third of the state.

Habitat. Usually associated with streams, but the seeds carried by birds have developed plum thickets elsewhere.

Prunus mexicana S. Wats. (Mexican Plum), reaches its northern limits in Labette county. It differs from *Prunus americana* in not sprouting from the roots, in not forming thickets; the bark somewhat furrowed (not scaly) on older trunks; leaves usually strongly tomentose beneath, commonly somewhat obtuse when they first unfold; flowers 15-18 mm. broad; fruit ripening later (October-November); and the stone obovoid to nearly round.

FIG. 164.—*Prunus americana.*

1. Winter twig, x 2.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Section of flower, enlarged.
5. Cluster of fruits, x ½.
6. Vertical section of fruit, x 1.

(From Pool: Nebraska Trees.)

PRUNACEÆ.

Prunus hortulana Bailey.

Wild Goose Plum.

Habit. A small tree similar to *Prunus americana,* singly or in groves, non-suckering.

Leaves. Alternate, simple, ovate-lanceolate to ovate or oblanceolate, long acuminate, somewhat peachlike, closely glandular-serrate, glabrous above, and pubescent at least along the midrib and lateral veins beneath, 10-15 cm. long; petioles less than 2.5 cm. long, usually bearing two glands near the blade.

Flowers. April-May, about 12-15 mm. broad, before the leaves, few in lateral umbels; pedicels 11-21 mm. long; calyx lobes glandular-serrate, pubescent both within and without.

Fruit. Summer, drupe subglobose or short-oval, bright red, thin-skinned, with little or no bloom; stone swollen, not margined.

Twigs in Winter. Similar to *Prunus americana,* but buds smaller (about 3 mm.) not ciliate.

Bark and Wood. Bark thin.

Distribution in the State. Eastern fifth of the state.

Habitat. Rich bottom lands.

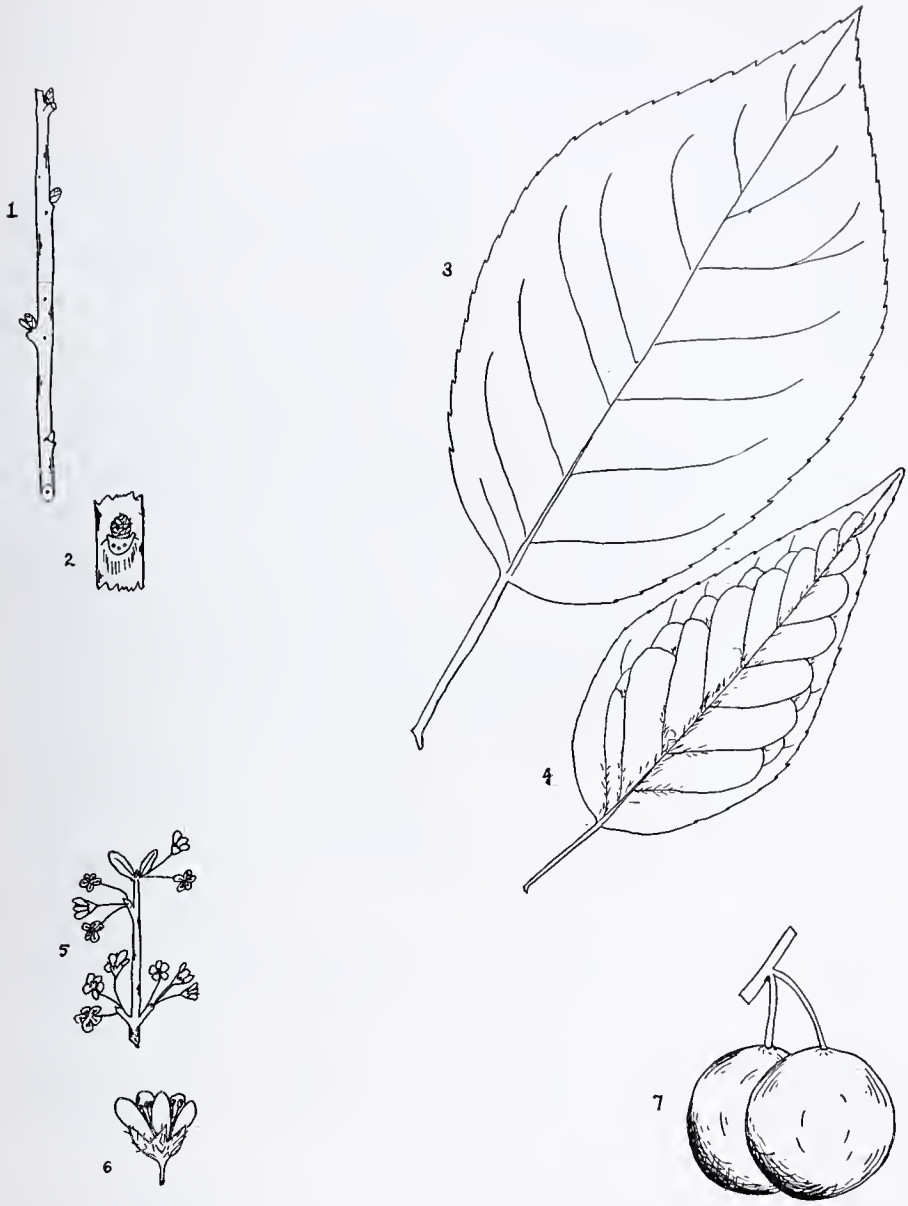

FIG. 165.—*Prunus hortulana.*

1. Terminal portion of winter twig, x 1.
2. Portion of winter twig, enlarged.
3. Upper view of leaf, x 1.
4. Leaf from beneath, x ½.
5. Inflorescence, reduced.
6. Flower, reduced.
7. Fruit, x 1.

(Original.)

PRUNACEÆ.

Prunus angustifolia Marsh.

(*Prunus angustifolia watsoni* [Sarg.] Waugh.)

Chickasaw Plum.

HABIT. Usually a dense thorny bush, in thickets; rarely a tree; slender spreading branches.

LEAVES. Alternate, simple, elliptic-lanceolate, acute at the apex, serrulate, often rounded at the base, glabrous when mature, 2-6 x 1-2 cm.; petioles usually biglandular.

FLOWERS. April, before the leaves, in lateral umbels, less than 1 cm. across, calyx-lobes ciliate, glabrous except at the base within, otherwise similar to those of *Prunus americana.*

FRUIT. May-July, globose drupe, red, nearly without bloom, thin-skinned, 12-16 mm. in diameter, the ovoid stone almost as thick as wide, rounded at both sutures, one of them minutely grooved. (In *P. angustifolia watsoni* rather smaller than this, thick-skinned, and ripening in August and September.)

TWIGS IN WINTER. Rigid, often rather thorny, dark. Terminal bud absent; lateral buds acuminate, 1.5 mm. long, with chestnut-brown scales. Leaf scars small; bundle scars 3; stipule vestiges or scars present.

BARK AND WOOD. Bark of twigs bright red and shining becoming dull, darker and often brown, marked with occasional horizontal orange-colored lenticels, dark, thin, glabrous. Wood soft, reddish brown.

DISTRIBUTION IN THE STATE. A pyramid having its apex in Riley county and its base spread across all but the two westermost counties on the southern boundary of the state.

HABITAT. Common on sand dunes of the wide river bottoms.

REMARKS. Certain cultivated plums owe their origin to this species.

The variety, *P. angustifolia varians* Wright & Hedrick, occurs in southeastern Kansas.

Prunus munsoniana Wright & Hedrick (Wild Goose Plum) reaches into southeastern Kansas. It differs from *Prunus angustifolia* in having leaves 6-10 cm. long (instead of 2-6 cm.) and the lobes of the calyx glandular.

Prunus orthosepala Koehne, of north central Kansas, is a shrub, differing from *Prunus angustifolia* in having rather oblong-lanceolate to obovate-lanceolate leaves mostly 4-6 x 1 to 2.5 cm.; flowers 10-14 mm. broad; and fruit (plums) about 2.4 cm. in diameter ripening in autumn.

Prunus mahaleb L. (Mahaleb Cherry), with corymbose flowers terminating twigs of the season, is recorded from four widely separated counties, viz., Miami, Lincoln, Sheridan and Haskell. It is a native of Europe.

In cultivation and possibly occasionally also as escapes may be found: *Prunus armeniaca* L. (Apricot), *Prunus avium* L. (Sweet Cherry), *Prunus cerasus* L. (Sour Cherry), *Prunus domestica* L. (Plum) and *Prunus* (*Amygdalus*) *persica* Sieb. & Zucc. (Peach).

FIG. 166.—*Prunus angustifolia.*

1. Winter twig, including terminal portion. x 1.
2, 3. Portions of winter twigs, enlarged.
4. Portion of branch, showing spiny twigs, reduced.
5. Leafy branch, x ½.
6. Leaf, x 1.
7. Inflorescence, reduced.
8. Flower, enlarged.
9. Fruiting branch, x 1.
10. End view of seed, x 1.
11. Side view of seed, x 1.

(Original.)

PRUNACEÆ.

Prunus virginiana L. (*P. nana, Padus nana*).

Choke Cherry.

Habit. Large shrub or a small tree up to 7 meters (23 ft.) in height, trunk diameter under 15 cm. The crooked branches and twigs forming a rather rounded crown.

Leaves. Alternate, simple, 5-10 cm. long, 4-5 cm. wide, thin, oblong or oval, abruptly pointed at the tip, finely and sharply serrate, the teeth pointing forwards and not turned in, dull dark green above, paler beneath, glabrous on both sides; petioles short, slender, glandular.

Flowers. May or early June, when the leaves are about half-grown, perfect, borne on short, slender pedicels in several-flowered clusters, 5-10 cm. long, spreading or drooping; calyx cup-shaped, 5-lobed; petals 5, white, borne on the rim of the calyx cup as are also the numerous stamens; ovary club-shaped.

Fruit. August, a spherical, dark red, yellow or black cherry, 8-11 mm. thick, very astringent but edible; stone globular.

Twigs in Winter. Slender, subterete, reddish brown or dark brown, shiny. Pith roundish, continuous. Terminal bud 6-12 mm. long, conical, pointed, scales rounded at the tip, light brown, glabrous, pitted; lateral buds the same but somewhat smaller, and divergent in early spring. Leaf scars half-elliptical, small; bundle scars 3, usually minute; stipule vestiges or scars present.

Bark and Wood. Bark reddish-brown or dark brown or almost black on the main trunk, fissured and sometimes more or less scaly. Wood heavy, hard, close-grained, weak, light to dark brown, with thick, lighter colored sapwood.

Distribution in the State. Eastern third or a little further west. The variety, *demissa,* in the western part of the state.

Habitat. Prefers moist rich loam of woodlands and river banks, but also grows in drier and poorer soils.

Remarks. In the western variety, *Prunus virginiana demissa* (Nutt.) Torr., the leaves are pubescent beneath and the fruit is red or purplish.

FIG. 167.—*Prunus virginiana.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Margin of leaf, enlarged.
5. Flowering branchlet, x ½.
6. Vertical section of flower, enlarged.
7. Fruit, x ½.

(From Otis: Michigan Trees.)

PRUNACEÆ.

Prunus serotina Ehrh.

Black Cherry.

Habit. A medium-sized tree 9-15 meters (30-50 ft.) high and 15-50 cm. in trunk diameter; branches few, large, tortuous, forming a rather spreading, oblong or rounded crown.

Leaves. Alternate, simple, 4-13 cm. long, about one-half as broad; oval or oblong to oblong-lanceolate; finely serrate, with teeth incurved; subcoriaceous; dark green and very shining above, paler beneath, glabrous both sides; petioles short, slender, usually bearing 2 red glands near the blade.

Flowers. May-June, when the leaves are half grown; perfect; 6 mm. across, borne on slender pedicels in many-flowered, loose racemes 5-10 cm. long; calyx cup-shaped, 5-lobed; petals 5, white; stamens 15-20, stigma thick, club-shaped.

Fruit. August-September; a globular drupe, 8-12 mm. in diameter, nearly black, with dark purple, juicy flesh; slightly bitter, edible, stone small.

Twigs in Winter. Twigs slender, subterete, reddish brown, glabrous. Pith roundish, continuous. Terminal bud about 6 mm. long, ovoid, blunt to acute, scales keeled on the back, apiculate, light brown. Leaf scars raised on a cushion flanked by the stipule vestiges or scars, half-elliptical, small; bundle scars 3, usually minute.

Bark and Wood. Young trunks dark red-brown, smooth; blackish on old trunks and rough, broken into thick, irregular plates; bitter, aromatic. Wood light, rather hard, strong, close- and straight-grained, light brown or red, with thin, yellow sapwood.

Distribution in the State. Eastern fourth of the state.

Habitat. In rich bottom lands, but grows well on dry, gravelly or sandy soil.

FIG. 168.—*Prunus serotina.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ¾.
4. Margin of leaf, enlarged.
5. Flowering branchlet, x ½.
6. Vertical section of flower, enlarged.
7. Fruiting branchlet, x ½.

(From Otis: Michigan Trees.)

CASSIACEÆ.

Cercis canadensis L.

Redbud or Judas-Tree.

Habit. A small tree 3-9 meters (10-30 ft.) high, with a trunk diameter of 13-20 cm.; divided near the ground into stout, straggling branches to form a broad, flat crown; often low and bushy.

Leaves. Alternate, simple, 5-10 cm. long and broad; heart-shaped or rounded with an abruptly tapering point; entire; thick; glabrous, dark green above, paler beneath, turning bright yellow in autumn; petioles slender, terete, enlarged at the base.

Flowers. April-May, before or with the leaves; perfect; 12 mm. long; borne on short, jointed pedicels in fascicles of 4-8; calyx campanulate, 5-toothed, dark red; petals 5, rose color; stamens 10, in 2 rows; pistil 1.

Fruit. June-July, remaining on the tree until early winter; a short-stalked legume 5-10 cm. long, 12 mm. wide, pointed at both ends, brown color; seeds 8-12, brownish, 6 mm. long, very hard.

Twigs in Winter. Moderate, zigzag, subterete, shiny, brownish or blackish, speckled. Pith roundish, continuous, pale or pinkish. Terminal bud absent; lateral buds 3 mm. long, glabrous, flattened, superposed, appressed, the upper slightly stalked, the lower sessile and covered by the top of the leaf scar, with 2 or, in case of flower-buds, several often keeled scales. Leaf scars 2-ranked, somewhat raised, obtusely triangular, with decurrent ridges, fringed at the top; bundle scars 3; stipule scars lacking.

Bark and Wood. Bark red-brown, deeply fissured, with a scaly surface on old trunks. Wood heavy, hard, coarse-grained, weak, dark red-brown, with thin, lighter colored sapwood.

Distribution in the State. Eastern two-fifths of the state.

Habitat. Prefers the borders of streams and rich bottom-lands, often in the shade of other trees. Common along small creeks and stony draws.

Remarks. An attractive ornamental small tree.

FIG. 169.—*Cercis canadensis.*

1. Winter twig, x 1.
2. Portion of twig, front view, enlarged.
3. Portion of twig, side view, enlarged.
4. Leaf, x ½.
5. Flowering branchlet, x 1.
6. Vertical section of flower, enlarged.
7. Fruit, x ½.

(From Otis: Michigan Trees.)

CASSIACEÆ.

Gleditsia triacanthos L.

Honey Locust.

Habit. Tree, 9-15 meters (30-50 ft.) high, trunk diameter 30-60 cm. Trunk dividing 2-5 meters above the ground into several large upright branches which divide many times into long, slender, ascending and horizontal branchlets and zigzag twigs, forming a widely spread, rounded crown. Trunk and main branches usually armed with stout, rigid, maroon, simple or branched thorns, 3-20 cm. long.

Leaves. Alternate, pinnately or bipinnately compound, 15-25 cm. long. Leaflets 18 or more, 18-40 mm. long, one-third as broad; lanceolate-oblong; remotely crenulate-serrate; thin; shiny, dark green above, dull yellow-green beneath. Petioles and rachises more or less pubescent.

Flowers. May-June, when the leaves are nearly full grown; polygamo-diœcious; the staminate in short, many-flowered, pubescent racemes; the pistillate in slender, few-flowered racemes on shoots of the preceding year; calyx bell-shaped, hairy, 3-5-lobed; petals 3-5, greenish; stamens 3-10; ovary 1-celled, woolly.

Fruit. Autumn, falling in early winter; flat, pendent, twisted, brown legume, 15-30 cm. long and about 2.5 cm. wide, short-stalked in short racemes, pubescent, becoming glabrous; seeds 6-27, oval, flattened, olive-colored or brown, exceedingly hard.

Twigs in Winter. Moderate, somewhat nodose and zigzag, irregularly terete, smooth, shiny, reddish- or grayish-brown. Pith rounded, continuous, pale or pinkish. Terminal bud lacking; the lateral buds glabrous, minute, 3 or more superposed, the uppermost often developing into a spine or replaced by an inflorescence scar, the others more or less covered by the torn margin of the leaf scar. Leaf scars rather large, irregularly shield-shaped; bundle scars 3; stipule scars lacking.

Bark and Wood. Bark thick on the trunk, iron-gray to blackish and deeply fissured into long, narrow ridges roughened by small scales. Wood hard, strong, coarse-grained, durable in contact with the ground, red-brown, with thin, pale sapwood.

Distribution in the State. Eastern half of the state.

Habitat. Prefers deep, rich loam, but grows on a variety of soils.

Remarks. A very valuable tree for planting in the plains states.

Individuals without thorns are known as *Gleditsia triacanthos inermis* Willd.

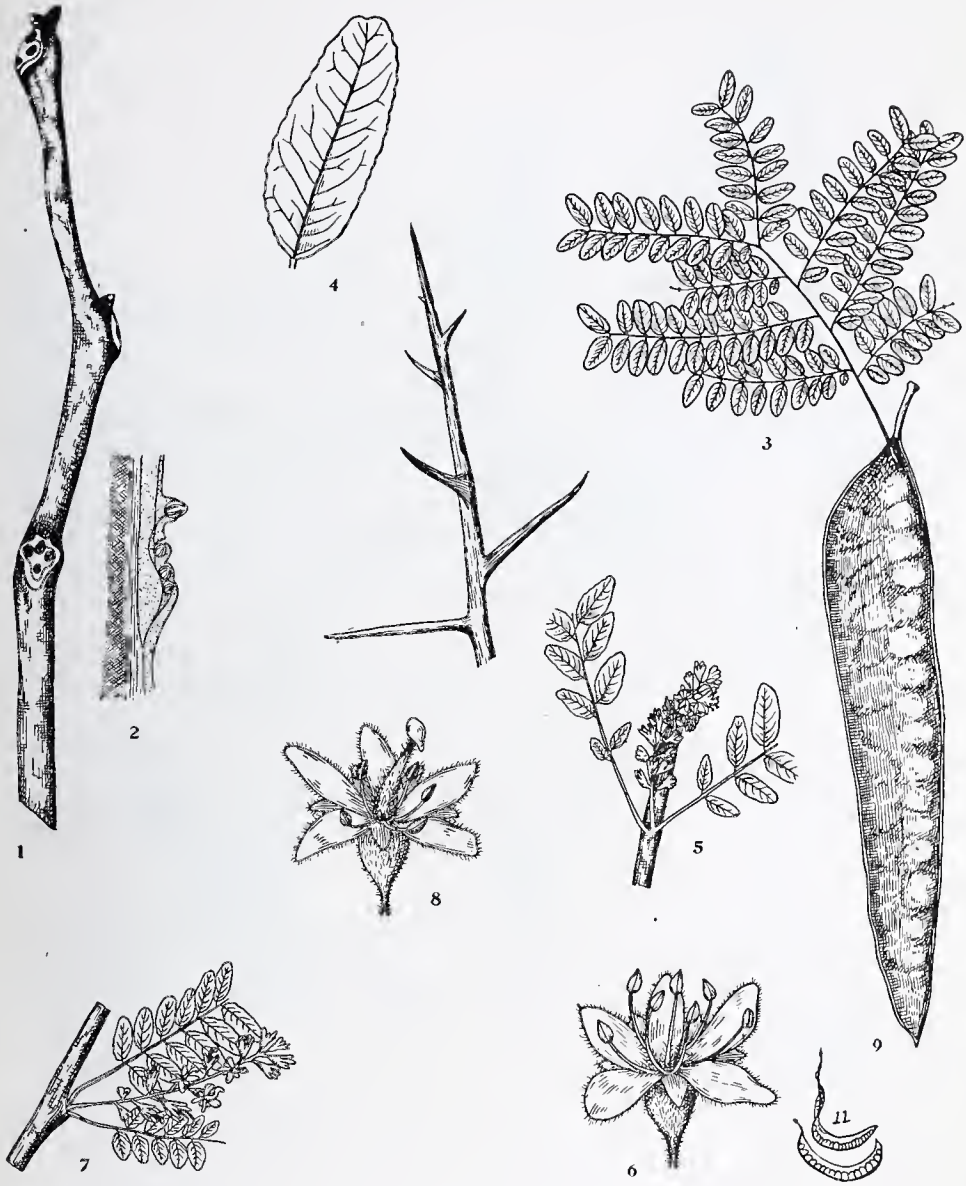

FIG. 170.—*Gleditsia triacanthos.*

1. Winter twig, x 1.
2. Vertical section through lateral buds, enlarged.
3. Leaf, x ¼.
4. Leaflet, x 1.
5. Staminate flowering branchlet, x ½.
6. Staminate flower, enlarged.
7. Pistillate flowering branchlet, x ½.
8. Pistillate flower, enlarged.
9. Fruit, flattened, x ⅓.

Center. Spine from trunk, x ½.

11. Mature fruit showing typical shapes, x 1/18. (Original.)

(From Otis: Michigan Trees.)

CASSIACEÆ.

Gymnocladus dioica (L.) Koch.

Coffee-tree.

Habit. A rather slender tree 9-12 meters (30-40 ft.) high, with a trunk diameter of 15-50 cm.; divides near the ground into several stems which spread slightly to form a narrow, pyramidal crown; branchlets stout, clumsy, blunt, with conspicuous leaf-scars.

Leaves. Alternate, bipinnately compound, 30-120 cm. long, appearing late in spring. Leaflets 40 or more, 2.5 to 5 cm. long and one-half as broad; short-stalked; ovate, acute; entire; thin and firm; dark green above, pale yellow-green and glabrous beneath. Petioles stout, terete, glabrous.

Flowers. June, after the leaves; diœcious; greenish white; the staminate short-stalked, in loosely-flowered clusters 5-12 cm. long; the pistillate long-stalked, in racemes 20-30 cm. long; calyx tubular, hairy; petals 5, keeled, nearly white; stamens 10; ovary hairy.

Fruit. Ripens in autumn, but remains closed until late in winter; short-stalked, red-brown legumes 8-20 cm. long, 2.5 to 5 cm. wide, 6-12 mm. thick, containing 1-8 large, flat olive-colored very hard seeds imbedded in a greenish, sweetish pulp.

Twigs in Winter. Stout, terete or nearly so, light brown, mottled. Pith large, cylindrical, continuous, salmon or chocolate-colored. Terminal bud absent; lateral buds superposed in raised silky craters, indistinctly scaly, bronze brown. Leaf scars large, irregularly heart-shaped; bundle scars 3 or 5, large, rather indefinite and divided; stipule scars minute and fringed at the top, or lacking.

Bark and Wood. At first greenish, bluish or purplish, often coated with short densely aggregated reddish hairs, becoming light brown and smooth; on old branches and the main trunk, thick and deeply fissured and scaly, the scales often very hard and resistant and attached by one side, dark reddish-gray, quite red beneath the bark scales. Wood heavy, somewhat soft, strong, coarse-grained, very durable in contact with the soil, light red-brown, with thin, lighter colored sapwood.

Distribution in the State. Eastern half of the state.

Habitat. Prefers bottom lands and rich soil, but often found in groups in rocky ravines some distance from other timber.

Remarks. A valuable tree, both as an ornamental and for the wood.

FIG. 171.—*Gymnocladus dioica.*

1. Winter twig, x 1.
2. Leaf, x ¼.
3. Leaflet, x ½.
4. Vertical section of staminate flower, enlarged.
5. Vertical section of pistillate flower, enlarged.
6. Fruit, x ¼. (Original.)

(From Otis: Michigan Trees.)

FABACEÆ.

Sophora japonica L.

Japanese Pagoda Tree.

Habit. Tree to at least 14 meters (46 ft.), with spreading branches forming a rounded crown.

Leaves. Alternate, compound, 18-23 cm. long; leaflets 7-17, distinctly stalked, ovate to ovate-lanceolate, 2.5 to 5 cm. long, acute, entire, rounded at the base, dark green and glossy above, more or less pubescent beneath.

Flowers. Summer, papilionaceous, about 1.5 cm. long, in large, loose, pendent clusters, about 30 cm. long; calyx with 5 short teeth; standard orbicular or broadly ovate; stamens 10, distinct or nearly so; pistil 1.

Fruit. Autumn, stalked, almost terete, 5-9 cm. long, glabrous, few to many seeded, moniliform, indehiscent or tardily dehiscent. Seeds bean-shaped, black.

Twigs in Winter. Moderate, swollen at the nodes, light or deep green, more or less zigzag with elongated internodes, subterete or angled. Pith somewhat 3 or more sided, continuous, pale or greenish. Terminal buds lacking; lateral buds woolly, superposed, small and at first concealed by the leaf scar. Leaf scars raised, from nearly circular or deltoid becoming narrowly U-shaped by the tearing of the articular membrane; bundle scars 3; stipule scars or remnants minute, at the upper angles of the leaf scar.

Bark and Wood. Bark on twigs, dull to bright olive green, becoming blackish; shallowly furrowed into longitudinal ridges.

Distribution in the State. Introduced about 20-30 years ago and cultivated in a few places. Native of China.

Habitat. Good soil.

Remarks. A very attractive ornamental tree, especially when in flower. Seeds have been produced by trees 16 years of age.

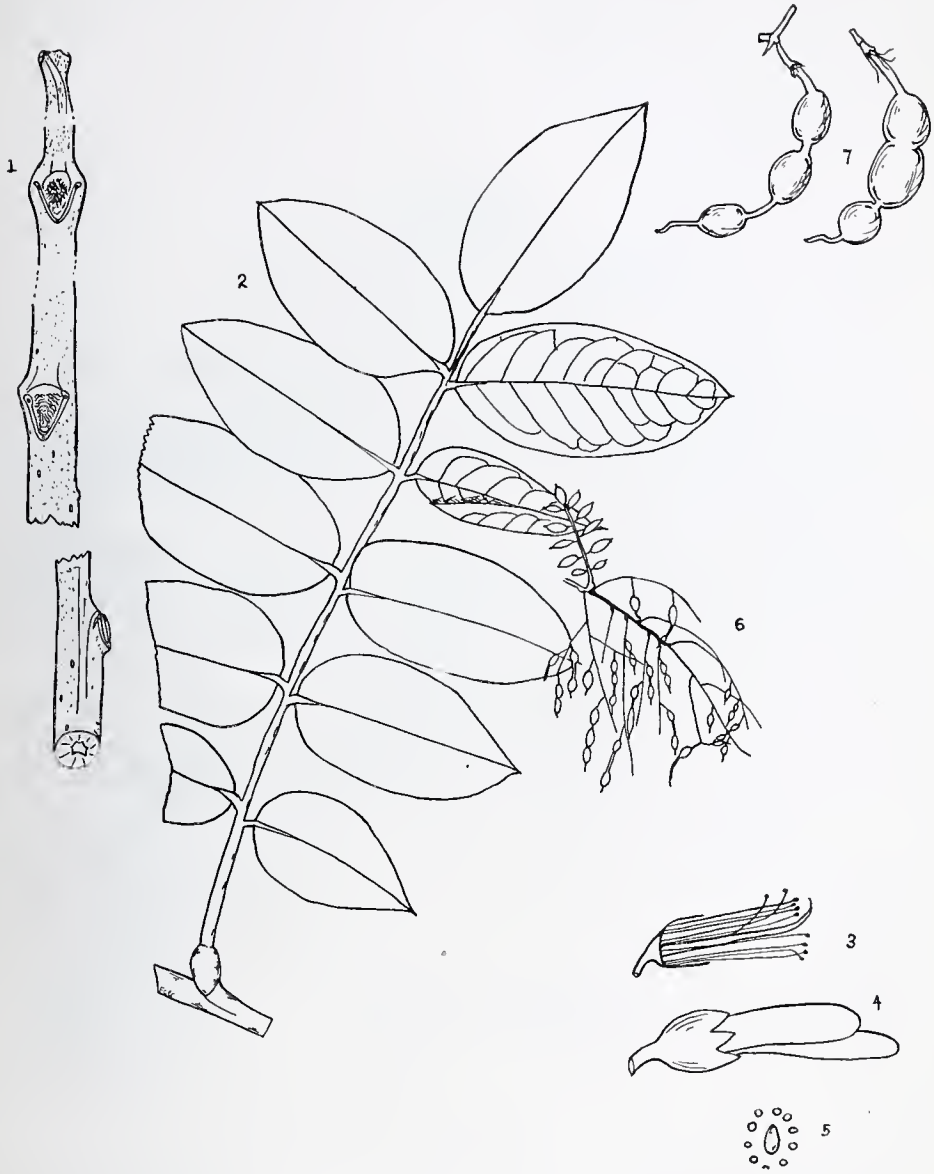

FIG. 172.—*Sophora japonica.*

1. Winter twig, x 1½.
2. Leaf, x ½.
3, 5. Diagrams of flower showing separate stamens.
4. Side view of flower, x 1.
6. Fruiting inflorescence, greatly reduced.
7. Fruits, x ½.

(Original.)

FABACEÆ.

Cladrastis lutea (Michx. f.) Koch.

American Yellowwood.

Habit. Tree up to 12 meters (40 ft.) high and trunk diameter of under 50 cm. Branches ascending into a rounded-topped tree.

Leaves. Alternate, pinnately compound, petioled, the petiol base hollow, nearly glabrous; leaflets 5-11, ovate, oval or obovate, stalked, 5-10 cm. long, pointed or blunt-acuminate at the apex, obtuse or the terminal one wedge-shaped at the base.

Flowers. Late May-June; fragrant, in many-flowered drooping terminal panicles 25-50 cm. long; pedicels slender, 11-19 mm. long; calyx tubular-campanulate; petals white; stamens 10, all distinct; pistil 1, sessile, style incurved.

Fruit. Summer, often persisting through the winter, a short-stalked legume, glabrous, 5-10 cm. long, 8-11 mm. wide, 2-6-seeded.

Twigs in Winter. Moderate, terete, brown, sometimes zigzag. Pith moderate, cylindrical, continuous, usually pale. Terminal bud lacking; lateral buds not distinctly scaly in superposed aggregates, appearing at a glance as a very large, brown, woolly bud. Leaf scars 2-ranked, narrowly U-shaped and encircling the buds, slightly raised; bundle scars 5; stipule scars lacking.

Bark and Wood. Bark rather smooth, dark. Wood yellow, hard, strong, yielding a yellow dye.

Distribution in the State. Native to the southeastward of the state, but planted in it.

Habitat. Prefers rich soil.

Remarks. An attractive ornamental tree.

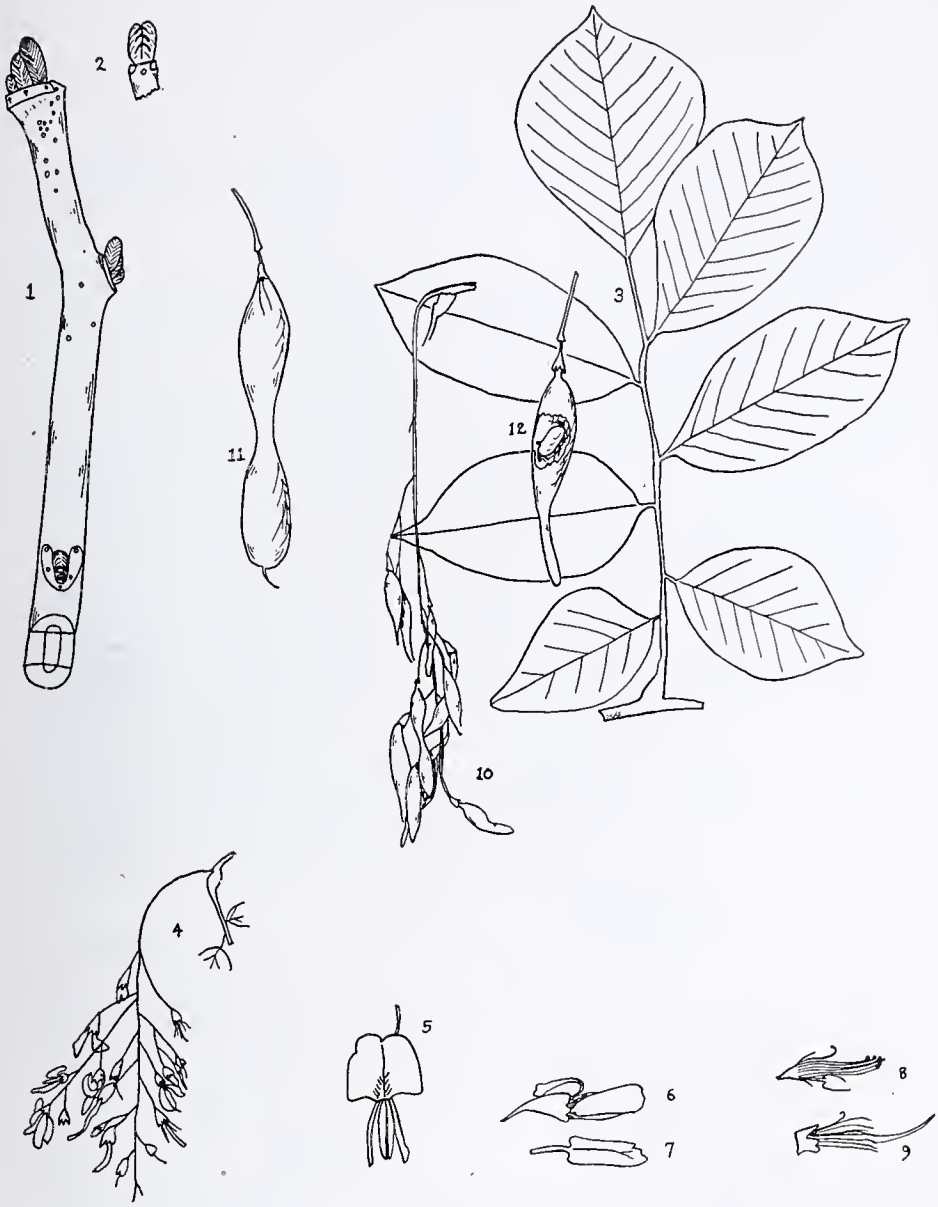

FIG. 173.—*Cladrastis lutea.*

1. Winter twig, x 1.
2. End view of tip of twig, showing absence of terminal bud, x 1.
3. Leaf, x ¼.
4. Inflorescence, greatly reduced.
5. Front view of flower, x ½.
6. Side view of flower, x ½.
7. Side or wing petal, x ½.
8. Flower, showing separate stamens.
9. Older flower with pistil expanding.
10. Fruiting cluster, x ¼.
11. Fruit, x ½.
12. Fruit, partly cut away to show seed, x ½.

(Original.)

FABACEÆ.

Robinia pseudoacacia L.

Black Locust.

Habit. A tree up to 12 meters (40 ft.) high, with a trunk diameter of 30-50 cm., forming a narrow, oblong crown of irregular, more or less bent and twisted branches.

Leaves. Alternate, pinnately compound, 15-30 cm. long. Leaflets 7-21, short-petiolate, 2.5 to 4 cm. long, about one-half as broad; ovate to oblong-oval; entire; very thin; dull dark green above, paler beneath, glabrous both sides. Petioles slender, more or less pubescent.

Flowers. May-June, after the leaves; perfect; showy and abundant; very fragrant; borne on slender pedicels in loose, drooping racemes 10-15 cm. long; about 12-25 mm. long; calyx short, bell-shaped, 5-lobed, hairy; corolla papilionaceous, white, 5-petaled; stamens 10, diadelphous; pistil 1.

Fruit. Late autumn, but persistent on the tree through the winter; a smooth, dark brown, flat, dry pod 7.5-10 cm. long and about 12 mm. wide, containing 4-8 small, flattish, olivaceous or brown, very hard seeds.

Twigs in Winter. Moderate, zigzag, more or less angled, reddish brown, armed with a pair of prickles at the node. Pith cylindrical, continuous, brown. Terminal bud absent; lateral buds small, 3-4 superposed beneath a membrane left after leaf-fall, rusty-hairy. Leaf scar broadly triangular or 3-lobed, consisting of a membrane which splits open later; bundle scars 3; stipules prickle-like.

Bark and Wood. Bark smooth, green, more or less rough-dotted at first, becoming red-brown and armed with prickles, which finally disappear; dark red-brown and thick on old trunks, deeply furrowed into firm, sinuous ridges. Wood heavy, very strong and hard, close-grained, very durable in contact with the soil, brown, with very thin, pale yellow sapwood.

Distribution in the State. Eastern half.

Habitat. Moist, well-drained soil, but does well under a great variety of conditions.

Remarks. Often planted for its durable wood, as well as its ornamental qualities, but short-lived (although rapid-growing when young) and seriously attacked by borers. Spreads readily by underground stems.

Robinia viscosa Vent (Clammy Locust), with glandular twigs and petioles, hispid pods and pinkish flowers is a closely related tree which is sometimes planted as an ornamental.

Robinia hispida L. (Rose Acacia or Bristly Locust), with bristly twigs and petioles, hispid pods, pink or purple flowers, is a closely related shrub, which is occasionally planted as an ornamental.

HAMAMELIDACEÆ.

Liquidambar styraciflua L. (Red Gum or Sweet Gum), of further east, a large, beautiful tree, with corky-winged branchlets, palmately-lobed leaves, and fruits aggregated in heads 2-4 cm. in diameter with the horn-like, woody styles conspicuous on the periphery, is planted in the eastern fifth of the state.

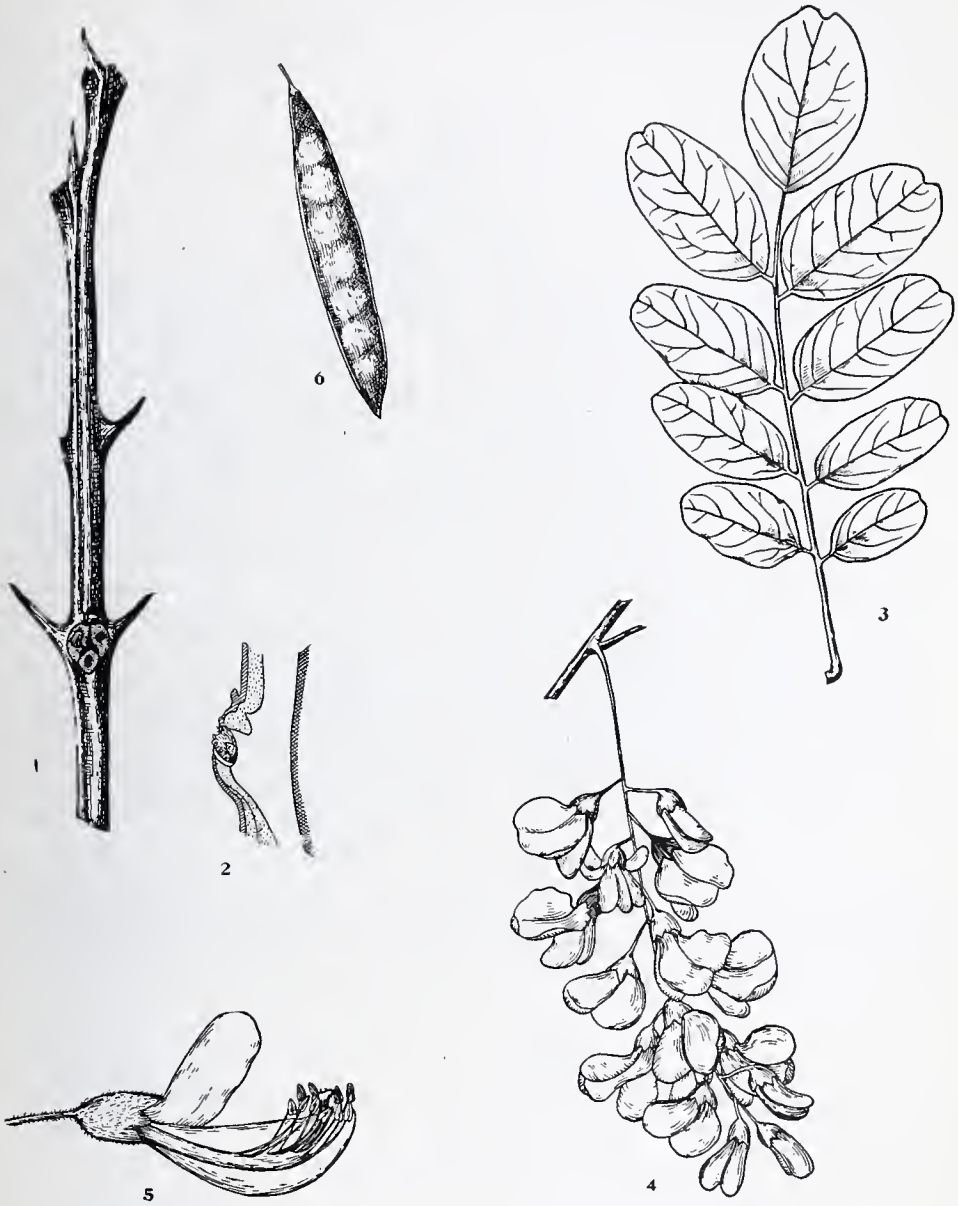

FIG. 174.—*Robinia pseudoacacia.*

1. Winter twig, x 1.
2. Vertical section through lateral buds, enlarged.
3. Leaf, x ½.
4. Raceme of flowers, x ½.
5. Flower, with part of corolla removed, enlarged.
6. Fruit, x ½.

(From Otis: Michigan Trees.)

PLATANACEÆ.

Platanus occidentalis L.

Sycamore.

Habit. A large tree 18-25 meters (60-83 ft.) high, with a trunk diameter of 1.5 to 3 meters commonly dividing near the ground into several large secondary trunks, forming a broad, open irregular crown of massive, spreading branches.

Leaves. Alternate, simple, 8-20 cm. long and broad; broadly ovate in outline; more or less 3-5-lobed by broad, shallow sinuses, the lobes sinuate-toothed; thin and firm; bright green above, paler beneath, glabrous both sides at least when mature; petioles stout, puberulous, 2.5 to 5 cm. long.

Flowers. May, with the leaves; monœcious; borne in dense heads; the staminate dark red, on short, axillary peduncles; the pistillate greenish, on long, slender, terminal peduncles; sepals 3-6, minute; petals 3-6, minute; stamens 3-6, usually 4; styles long, incurved, red.

Fruit. October, persistent on the limbs through the winter; brown heads about 2.5 cm. in diameter, on slender, glabrous stems 8-15 cm. long.

Twigs in Winter. Moderate, rounded, glabrous, brown, zigzag. Pith moderate, pale or brownish, rounded, continuous. Terminal bud lacking; lateral buds 6-9 mm. long, conical, blunt, with a single glossy, closed scale forming in summer within the petiole of the leaf. Leaf scars 2-ranked, very nearly a closed ring encircling the bud, somewhat crenate and raised; bundle scars 5, compound seeming 7-9, large; stipule scars narrow, encircling the twig.

Bark and Wood. Bark pale green and tomentose on twigs, becoming smooth, dark green, finally grayish, thick, red-brown on the trunk and broken into oblong, platelike scales, separating higher up into thin plates which peel off, exposing the greenish or whitish inner bark. Wood heavy, tough, hard, rather weak, coarse-grained, difficult to split, light, red-brown, with thick, darker colored sapwood.

Distribution in the State. Almost the eastern half of the state.

Habitat. Prefers rich bottom lands along the borders of rivers and lakes where it usually occurs as widely scattered individuals in a forest of elms, walnut and basswood, but grows readily in much drier situations, when planted.

Remarks. A beautiful, ornamental native tree, recognized at great distances by the whitish bark and the fluffy fruit balls.

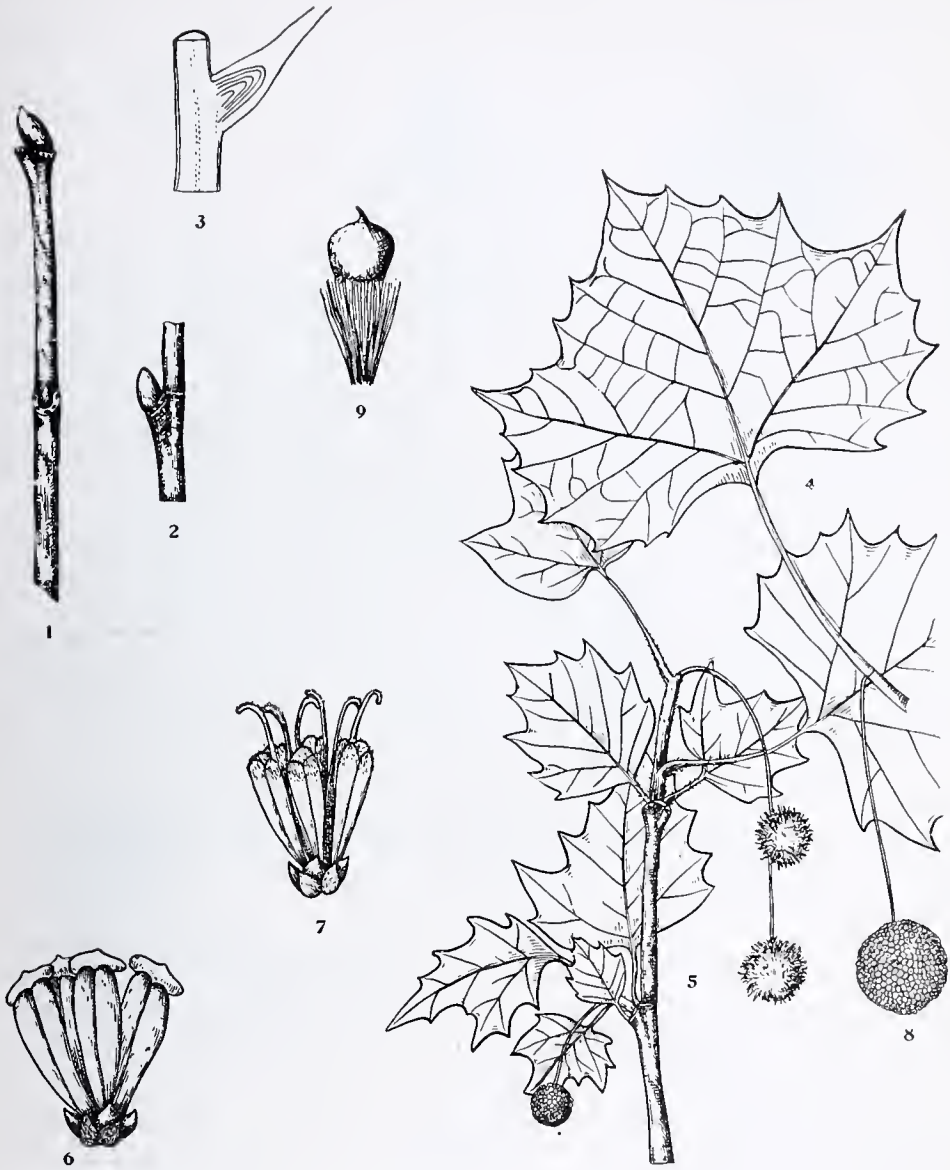

FIG. 175.—*Platanus occidentalis.*

1. Winter twig, x 1.
2. Portion of twig, side view, x 1.
3. Vertical section of twig, summer bud and leaf petiole, enlarged.
4. Leaf, x ⅜.
5. Flowering branchlet, x ½.
6. Staminate flower, enlarged.
7. Pistillate flower, enlarged.
8. Fruit, x ⅜.
9. Akene, enlarged.

(From Otis: Michigan Trees.)

ELÆAGNACEÆ.

Elæagnus angustifolia L.

Oleaster, Russian Olive.

Habit. Small tree usually under 9 meters (30 ft.) with a trunk diameter of 8-25 cm., erect or commonly leaning or twisted and distorted, producing an irregular tree, branching low to form a number of erect, or pendulous, irregular, often spiny branches.

Leaves. Alternate, simple, entire, or sometimes deeply lobed, lanceolate, narrowed at the base, obtuse or acute at the tip, grayish-green with scattered stellate hairs on upper surface, or finally dark green above, silvery gray beneath, 2.5 to 10 cm. long, 10-16 mm. wide; petioles short, stout.

Flowers. June; 1-few, perfect, in the axils of the leaves on very short pedicels; calyx rather tubular or bell-shaped, 6-12 mm. long, 6 mm. broad, 4-lobed, silvery gray on the outside, lemon-colored within, very fragrant; petals lacking; stamens 4, very short, attached near the throat of the calyx.

Fruit. Summer, olive-shaped or oblong drupe, about 12 mm. long and about ½ as thick, on a short stalk not over 6 mm. long, with a silvery-gray thin skin covering a thin layer of meaty tissue which in turn surrounds the oblong brown and yellow streaked stone, often persisting upon the trees into late fall or winter.

Twigs in Winter. Rather slender, terete, silvery-gray, densely covered with stellate hairs. Pith small, cylindrical, continuous. Buds small, solitary or collaterally branched in spine-formation, oblong with about 4 exposed scales, 3-6 mm. long, silvery-gray with prominent peltate scales, strongly divergent from the twigs. Leaf scars half-round, minute, more or less raised; bundle scar 1; stipule scar lacking.

Bark and Wood. Bark on two-year twigs glabrous, shiny, olive to dark brown; on older branches smooth, shiny, very dark brown, finally becoming shallowly furrowed, more or less stringy and dark reddish-brown or almost black. Wood dark brown, light, weak, coarse-grained, easily split and fairly durable in contact with the soil.

Distribution in the State. Native of southern Europe and western Asia, more or less freely planted in most parts of the state.

Habitat. Moist, rich soil in the open sunlight, but will do well in much less desirable circumstances.

Remarks. A very desirable ornamental tree, on account of its rapid growth, silvery color and fragrant flowers.

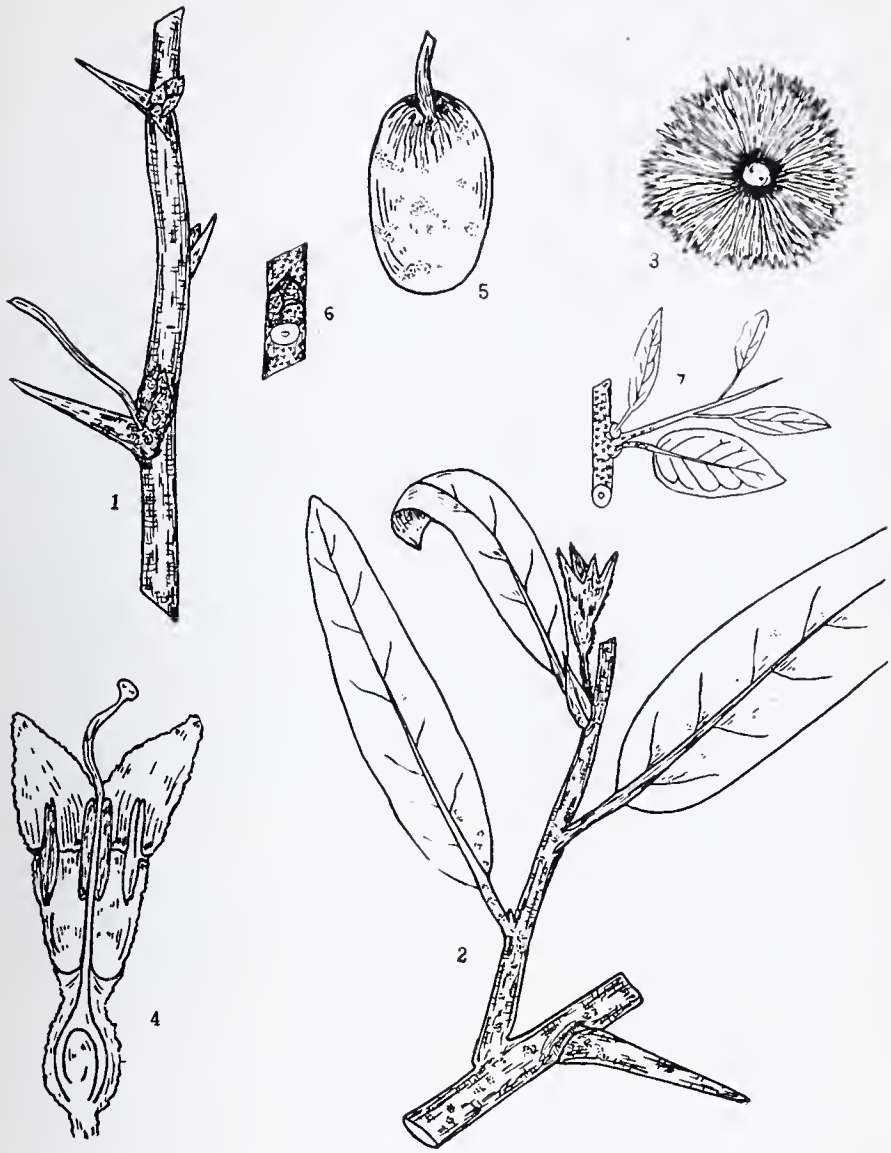

FIG. 176.—*Elæagnus angustifolia.*

1. Winter twig, x 1.
2. Leafy branchlet with flower, x 1½.
3. Peltate scale from the leaf, enlarged.
4. Vertical section of flower, enlarged.
5. Mature fruit, x 2.
6. Portion of a twig, showing bud and leaf scar, x 1. (Original.)
7. Portion of a leafy branch, reduced. (Original.)

(From Pool: Nebraska Trees.)

SAPINDACEÆ.

Sapindus drummondii H. & A.

Western Soapberry.

Habit. Tree up to 10 meters (33 ft.) high, and trunk diameter to 50 cm., or at its northern limit a shrub.

Leaves. Alternate, odd-pinnately compound, 12-40 or more cm. long; leaflets 7-19, inequilateral, obliquely-lanceolate, entire, 4-10 cm. long, acuminate at the apex and commonly acute at the base.

Flowers. May-June; regular, polygamo-diœcious, in terminal dense panicles 12-20 cm. long, white, about 4 mm. broad; sepals 4-5, imbricated in two rows; petals same number, ovate, each with a scale at its base; a disk below the pistil; stamens 8-10, inserted on the disk, anthers versatile; ovary usually 3-lobed, with the same number of cavities.

Fruit. Fall, a berry, globose or ovoid, 8-15 mm. diameter, very soapy, usually 1-seeded and with 2 abortive ovules at the base.

Twigs in Winter. Moderate or somewhat stout, somewhat fluted, dark. Pith rather large, roundish, continuous, pale. Terminal bud absent; lateral buds superposed, depressed-globose, with 2 exposed scales. Leaf scars little raised, rather large, triangular or somewhat 3-lobed; bundle scars 3, large but indistinct; stipule scars lacking.

Bark and Wood. Bark separating by deep fissures into long, narrow plates broken on the surface into small, reddish-brown scales. Wood heavy, hard, strong, close-grained, light yellowish-brown, with lighter colored sapwood.

Distribution in the State. Counties along most of the central southern border and rarely in places in Saline to Riley counties farther north.

Habitat. River valleys and hillsides.

Remarks. The very soapy berries formerly used as soap. Fruit ornamental, curious. Wood used in box manufacture in the south.

Koelreuteria paniculata Laxm., a Chinese tree, with pinnate leaves and terminal panicles of yellow flowers, followed by 3-lobed bladdery pods, is sometimes planted for ornament.

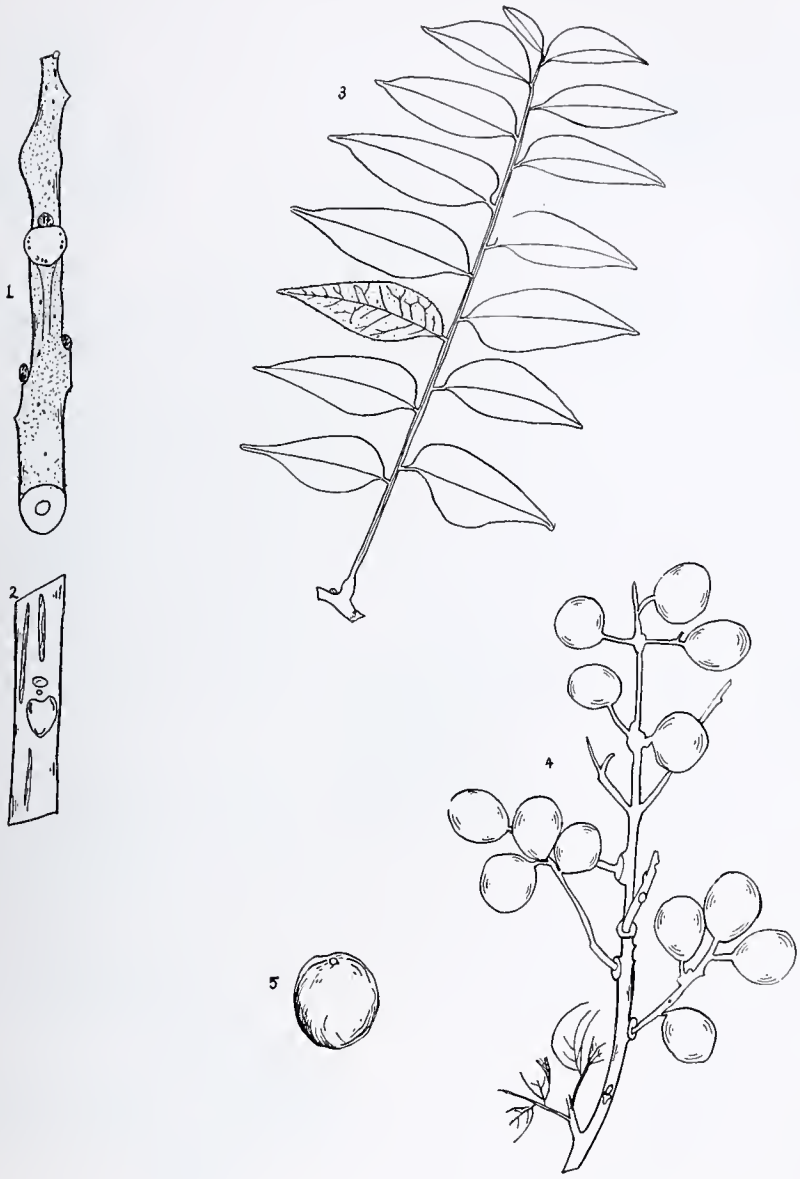

FIG. 177.—*Sapindus drummondii.*

1. Winter twig, x 1½.
2. Portion of three-year-old branch, showing longitudinal splitting of bark, x 1.
3. Leaf, x ¼.
4. Fruiting inflorescence, x ½.
5. Fruit, x 1.

(Original.)

ÆSCULACEÆ.

Æsculus hippocastanum L.

Horse Chestnut.

Habit. A handsome tree, with a height of 6-10 meters (20-33 ft) and a trunk diameter of 25-40 cm., forming a broad, conical crown. The regularly occurring branches ascend from the trunk at first, gradually bend downwards as they lengthen, and end in a thick, upturning spray.

Leaves. Opposite, palmately compound. Leaflets, usually 7, rarely 5, 13-18 cm. long, 2.5 to 5 cm. broad; obovate, wedge-shaped at the base; irregularly and bluntly serrate; thick; rough, dark green above, paler beneath, turning a rusty yellow in autumn: Petioles long, grooved, swollen at the base.

Flowers. May-June, after the leaves; polygamo-monœcious; large, whitish, in showy, upright, terminal clusters 15-25 cm. long; pedicels jointed, 4-6-flowered; calyx campanulate, 5-lobed; petals 5, white, spotted with yellow and red, each with a narrow stalklike base; stamens 7, threadlike, longer than the petals.

Fruit. October; a leathery, globular capsule about 2.5 to 5 cm., roughened with short spines; containing 1-3 large, smooth, shining, brown nuts, marked by large, pale scars.

Twigs in Winter. Stout, nearly terete, glabrous, reddish-brown. Pith large, rather 6-sided, continuous, pale. Buds, especially the uppermost, very large, gummy, ovoid, sessile, with some half a dozen pairs of exposed scales; the terminal may be 3 cm. long, but the lateral buds are somewhat or much smaller; inner scales lengthening greatly in spring and remaining until the leaves are nearly half grown. Leaf scars shield-shaped, large; bundle scars 3, or in 3 compound groups; stipule scars lacking.

Bark and Wood. Bark smooth, red-brown, shiny; on the trunk dark brown and broken into thin plates by shallow fissures; rich in tannin, bitter. Wood light, soft, close-grained, weak, whitish, with thin, light brown sapwood; of little value except for fuel.

Distribution in the State. Native of Greece, but quite frequently planted as an ornamental in Europe and eastern United States; less frequently in eastern Kansas.

Habitat. Rich soil, but will grow elsewhere.

Remarks. Attractive.

FIG. 178.—*Æsculus hippocastanum.*

1. Winter twig, x ¾.
2. Leaf, x ⅙.
3. Leaflet, x ½.
4. Flower, x 1.
5. Fruit, x ½.

(From Otis: Michigan Trees.)

ÆSCULACEÆ.

Æsculus glabra Willd.

Ohio Buckeye.

Habit. A medium-sized tree 6-10 meters (20-33 ft.) in height, with a trunk not over 40 cm. in diameter; usually much smaller; slender, spreading branches, forming a broad, rounded crown; twigs thick.

Leaves. Opposite, palmately compound. Leaflets usually 5, rarely 7, 8-15 cm. long, 2.5 to 5 cm. broad; ovate or oval, gradually narrowed to the entire base; irregularly and finely serrate; glabrous, yellow-green above, paler beneath, turning yellow in autumn. Petioles 10-15 cm. long, slender, enlarged at the base. Foliage ill-smelling when bruised.

Flowers. April-May, after the leaves; polygamo-monœcious; small, yellow-green, in terminal panicles 13-15 cm. long and 5-8 cm, broad, more or less downy; pedicels 4-6-flowered; calyx campanulate, 5-lobed; petals 4, pale yellow, hairy, with a stalklike base; stamens 7, with long, hairy filaments.

Fruit. October; a thick, leathery, prickly, brownish capsule, about 2.5 cm. in diameter, containing a single large, smooth, shining, brown nut. A large pale scar gives the name "Buckeye."

Twigs in Winter. Moderately stout, nearly terete, glabrous, orange to brown. Pith large, rather 6-sided, continuous, pale. Buds large, especially the terminal, which is about 2 cm. long, little if any wider than the twig itself, outer scale whitish, inner yellowish-green, enlarging greatly in spring and remaining until the leaves are about half grown. Leaf scars triangular; bundle scars 3 or in 3 compound groups; stipule scars lacking.

Bark and Wood. Bark smooth, red-brown, becoming ashy gray; on old trunks densely furrowed and broken into thick plates, ill-smelling when bruised. Wood light, soft, close-grained, weak, whitish, with thin, light brown sapwood.

Distribution in the State. Extreme eastern part of the state, but planted further west.

Habitat. Moist soil in woods along rivers or uplands close by.

FIG. 179.—*Æsculus glabra.*

1. Winter twig, x 1.
2. Leaf, x ⅙.
3. Leaflet, x ½.
4. Flower, x 2.
5. Fruit, x ½.
6. Nut, x ½.

(From Otis: Michigan Trees.)

ÆSCULACEÆ.

Æsculus arguta Buckl.

Western Buckeye.

Habit. Shrub, 1-3 meters (3-10 ft.) high, or a small tree.

Leaves. Opposite, palmately compound, leaflets 7-9, narrow, 8-15 cm. long, 2.5 to 5 cm. wide, long-acuminate, unequally serrate, somewhat pubescent becoming glabrate; petioles 8-10 cm. long, pubescent becoming glabrate, slender, enlarged at the base.

Flowers. April-May, after the leaves; polygamo-monœcious; small, yellow, in terminal panicles 10-15 cm. long; calyx broadly campanulate, its lobes very obtuse; stamens 7, exerted, curved; petals parallel, 11-13 mm. long, the upper two with stalklike base and an expanded ovate, recurved terminal portion, at first yellow, but the claw becoming rust color on the inside.

Fruit. October, a thick, leathery, spiny, brownish capsule (especially spiny when young), about 2.5 cm. in diameter, containing a single large, smooth, shining, brown nut, with a large pale scar at the base.

Twigs in Winter. Moderately stout, nearly terete, glabrous, orange to brown. Pith large, rather 6-sided, continuous, pale. Buds large, especially the terminal, which is about 2 cm. long, little if any wider than the twig itself; outer scales whitish-brown, inner yellowish-green, enlarging greatly in spring and remaining until the leaves are about half grown. Leaf scars triangular, large; bundle scars 3; stipule scars lacking.

Bark and Wood. Bark pubescent at first, but becoming smooth, reddish-brown, then ashy gray; on old trunks densely furrowed and broken into plates or scales. Wood light, soft, close-grained, weak, whitish, with thin, light brown sapwood.

Distribution in the State. Eastern third.

Habitat. Moist soil in woods along rivers.

Remarks. The young shoots poison stock, especially in springs that have had late severe frosts.

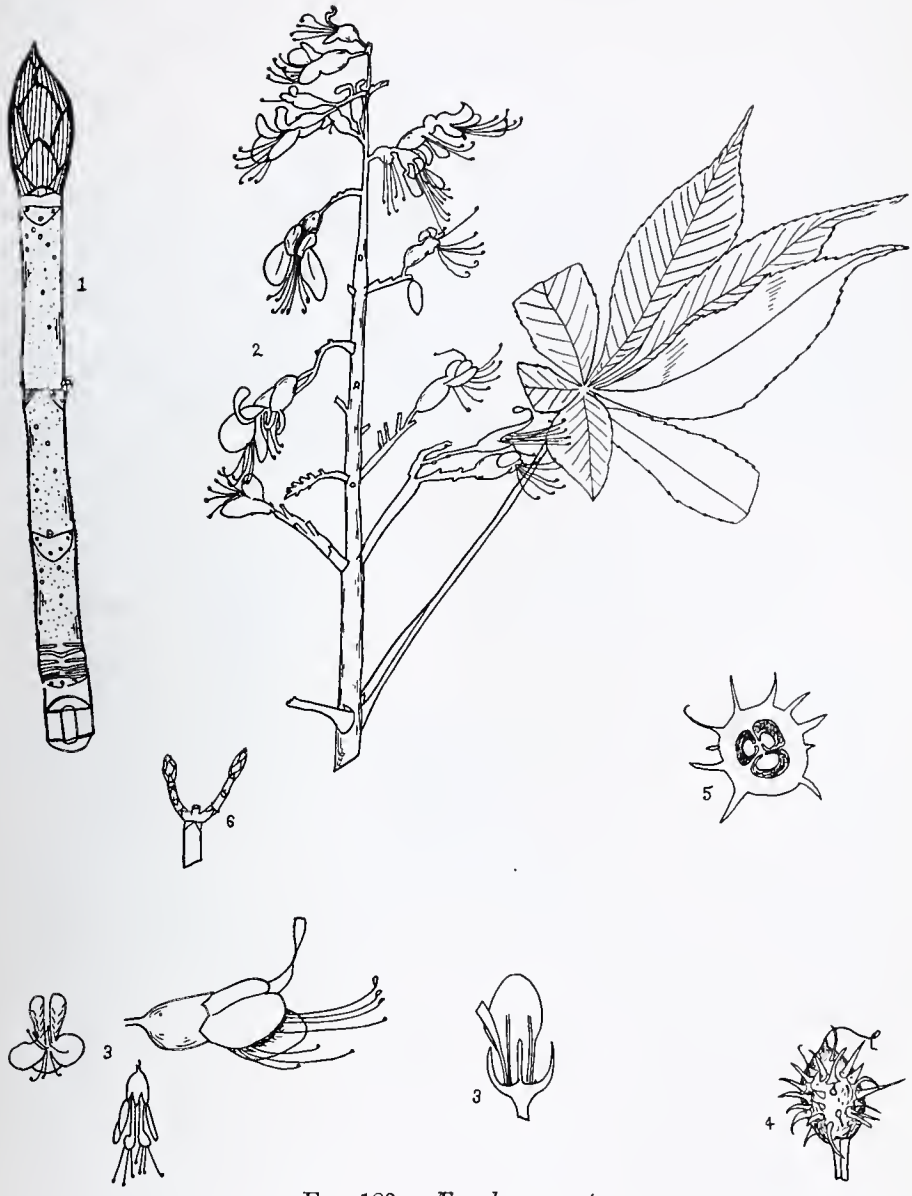

FIG. 180.—*Æsculus arguta.*

1. Winter twig, x 1.
2. Inflorescence, x ½.
3. Details of flowers.
4. Young fruit, x ½.
5. Section of young fruit, x ½.
6. Twig, showing scar left by former inflorescence, reduced.

(Original.)

ACERACEÆ.

Acer negundo L.

Boxelder, Ash-leaved Maple.

Habit. A tree 7-15 meters (25-50 ft.) high, with a trunk diameter of 30-60 cm., or westward more of a shrub. Trunk often divides near the ground into several stout, wide-spreading branches, forming a broad, unsymmetrical, open crown.

Leaves. Opposite, pinnately compound. Leaflets 3-5 in number, 5-10 cm. long, 4-6 cm. broad; ovate or oval; nearly entire, irregularly and remotely coarse-toothed above the middle, or sometimes 3-lobed (often giving the leaflet a jagged outline); apex acute, base variable; glabrous or somewhat pubescent at maturity, with prominent veins. Petioles slender, 5 to 7.5 cm. long, the enlarged base leaving prominent crescent-shaped scars partly surrounding the winter-buds.

Flowers. April-May, before or with the leaves; diœcious; small, yellow-green; the staminate in clusters on long, threadlike, hairy pedicels; the pistillate in narrow, drooping racemes; calyx hairy, 5 lobed; corolla 0; stamens 4-6; ovary pubescent, wing margined.

Fruit. Early summer, but hanging until late autumn or early spring; narrow, flat, winged samaras, 4-5 mm. long, in pairs, clustered in drooping, racemose clusters.

Twigs in Winter. Moderate, greenish to purple, glaucous, waxy. Pith continuous, cylindrical, white. Terminal bud 3-6 mm. long, acute, inclosed in two dull red scales, often hoary or minutely pubescent; lateral buds obtuse, appressed. Leaf scars crescent-shaped, meeting and (at least when young) continued upwards in a bristle; bundle scars 3; stipule scars absent.

Bark and Wood. Bark of twigs greenish to purple, glaucous, on the trunk pale gray or light brown, deeply cleft into broad ridges. Wood light, soft, close-grained, weak, creamy white, with thick, hardly distinguishable sapwood, often reddish-streaked, of little value, except as fuel and paper pulp.

Distribution in the State. The eastern three-quarters of the northern half of the state and the eastern half of the south part of the state, and planted beyond these limits.

Habitat. Banks and streams and borders of swamps preferred, but will grow in almost any situation not too dry.

Remarks. Variable and some of the variations named. Among such, *Acer negundo interius* (Britton), Sarg., of the Rocky Mountain region, found in western Kansas, differs principally in having the twigs densely velvety, with short spreading hairs and thicker leaves.

The red stain often noticed in the wood of boxelder is due to the growth of a fungus, *Fusarium negundi* Sherb., which enters through wounds and is usually spread from tree to tree by sapsuckers (E. E. Hubert in Journ. of Agricultural Research, 26:447-457, 1923).

FIG. 181.—*Acer negundo.*

1. Winter twig, x 1.
2. Leaf, x ½.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x 1.
8. Portion of twig showing upward projection of leaf scars, x 1. (Original.)

(From Otis: Michigan Trees.)

ACERACEÆ.

Acer saccharinum L.

Soft Maple, Silver Maple.

Habit. A beautiful tree, growing to a height of 18-25 meters (60-83 ft.), with a trunk diameter of 60-125 cm., usually separating near the ground into 3-5 upright stems which are destitute of branches for a considerable distance. Usually the long, slender branches bend downwards, but with their tips ascending in a graceful curve. Crown broad, especially in its upper portion.

Leaves. Opposite, simple, 8-18 cm. long and nearly as broad; usually palmately 5-lobed by narrow, acute indentations which extend nearly to the midrib, the lobes often sublobed, sharply toothed; light green above, silvery white beneath, turning pale yellow in autumn; petioles long, slender, drooping, red, glabrous.

Flowers. February-March, before the leaves; polygamo-monœcious or diœcious; small, yellow-green, in crowded, sessile umbels; calyx 5-lobed (sometimes each lobe again divided); corolla 0; stamens 3-7; ovary hairy, stigma 2-lobed, styles bright red.

Fruit. May, germinating as soon as it reaches the ground; paired samaras, large, glabrous, curving inwards, greenish yellow becoming light brown, one samara often aborted, borne on slender, drooping pedicels 4-7 cm. long.

Twigs in Winter. Moderate, reddish-brown, smooth. Pith cylindrical, continuous, pale. Buds moderate, solitary (or flower buds clustered on side spurs), dark red, blunt, the terminal about 6 mm. long, with pointed bud scales. Leaf scars U-shaped; bundle scars 3; stipule scars lacking.

Bark and Wood. On twigs smooth, reddish-gray, shining; on young trunks gray, smooth; on old trunks dark gray, more or less furrowed, separating into thin, loose scales. Wood hard, strong, close-grained, rather brittle, perishable, pale brown, with thick, lighter colored sapwood.

Distribution in the State. Eastern fourth of the state, but much planted farther westward.

Habitat. Low, rich bottom lands, subject to occasional inundation, but not in swamps; banks of rivers and lakes at low altitudes, but will grow under much drier situations. Not ordinarily beyond the high water mark on the larger streams.

Remarks. A rapid growing, relatively short-lived ornamental tree, subject to storm damage, but nevertheless much planted for ornament, windbreak and fuel.

Acer rubrum L. (Red Maple), a common tree East, may be planted. It differs from the Soft Maple in that the flowers have petals, the ovary is glabrous, the sides of the basal portion of the terminal lobe of the leaves converge (instead of diverging), the fruits are about one-half as long, the outermost twigs do not conspicuously curve upwards, and the bark, although rough, does not conspicuously flake off.

FIG. 182.—*Acer saccharinum.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaves, x ½.
4. Staminate flowering branchlet, x 1.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x 1.
7. Pistillate flower, enlarged.
8. Fruit, x ½.

(From Otis: Michigan Trees.)

ACERACEÆ.

Acer saccharum Marsh.

Sugar Maple, Hard Maple.

Habit. East a stately tree 20-30 meters (65-100 ft.) in height, with a trunk diameter 60-125 cm., but in this state hardly 18 meters (60 ft.) high; in the open forming stout, upright branches near the ground; in forests making remarkably clean trunks to a good height; the crown is a broad, round-topped dome.

Leaves. Opposite, simple, 8-13 cm. long and broad; usually palmately 5-lobed (sometimes 3-lobed), the lobes sparingly wavy-toothed and pointed, the sinuses broad and rounded at the base; thin and firm; opaque, dark green above, lighter and glabrous beneath, turning yellows and reds in autumn; petioles long, slender.

Flowers. May, with the leaves; polygamo-monœcious or diœcious; on threadlike, hairy pedicels in nearly sessile corymbs; greenish yellow; calyx campanulate, 5-lobed; corolla 0; stamens 7-8, borne upon the calyx rim; ovary hairy.

Fruit. September-October, germinating the following spring; paired samaras, glabrous, with wings about 2.5 cm. long, diverging slightly.

Twigs in Winter. Moderate, brown, smooth. Pith cylindrical, continuous, pale. Buds moderate, solitary, ovoid-conical, with several pairs of scales, red-brown, glabrous or somewhat pubescent toward the apex, terminal 6 mm. long, lateral smaller, appressed. Leaf scars U-shaped; bundle scars 3; stipule scars lacking.

Bark and Wood. Bark smooth, pale brown, becoming gray and smooth on the branches; on old trunks dark gray, deeply furrowed, often cleaving up at one edge in long, thick plates. Wood heavy, hard, strong, close-grained, tough, durable, capable of taking a fine polish, light brown, with thin, lighter colored sapwood.

Distribution in the State. The extreme eastern tier of counties from Kansas City south. Planted elsewhere.

Habitat. Prefers moist, rich soil in valleys and uplands, and moist, rocky slopes.

Remarks. Further east a very important tree for lumber, sugar and ornament, but it does not do well in this state.

FIG. 183.—*Acer saccharum.*

1. Winter twig, x 2.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x ½.
7 Pistillate flower, enlarged.
8. Fruit, x 1.

(From Otis: Michigan Trees.)

ACERACEÆ.

Acer nigrum Michx.

Black Maple, Black Sugar Maple.

Habit. A stately tree, sometimes reaching a height of about 24 meters (80 ft.), with a trunk diameter of 50-90 cm.; branches stout, forming a broad, rounded, symmetrical crown.

Leaves. Opposite, simple, concave, 12-18 cm. across, the breadth usually exceeding the length; green on both sides; usually 5-lobed at maturity, the two lower lobes being small, often reduced to a mere curve in the outline, the pointed lobes undulate or entire and narrowed from the broad, shallow sinuses; thick and firm; glabrous above, downy beneath; petioles stout, much enlarged at the base, usually pendent, tomentose. The sides of the larger leaves often droop.

Flowers. May, with the leaves; monœcious; in nearly sessile, umbellike corymbs; about 6 mm. long, yellow, on slender, hairy pedicels 5-8 cm. long; calyx campanulate, pilose, 5-lobed; corolla 0; stamens 7-8; ovary hairy.

Fruit. Ripens in autumn; glabrous, paired samaras, clustered on drooping pedicels; wings set wide apart, but only slightly diverging.

Twigs in Winter. Moderate, brown, smooth. Pith cylindrical, continuous, pale. Buds medium, ovoid, acute, with dark red-brown acute scales, hoary-pubescent; terminal about 3 mm. long, the lateral smaller. Leaf scars U-shaped; bundle scars 3; stipule scars lacking.

Bark and Wood. Bark thin, smooth, pale gray, becoming thick, deeply furrowed and sometimes almost black on the trunk. Wood hard, heavy, strong, close-grained, creamy-white, with thin, lighter colored sapwood.

Distribution in the State. Credited to "eastern Kansas" in Sargent. Planted also.

Habitat. Low, moist, rich soil of river-bottoms, but does well on gravelly soils and uplands.

FIG. 184.—*Acer nigrum.*

1. Winter twig, x 2.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

(From Otis: Michigan Trees.)

ACERACEÆ.

Acer platanoides L.

Norway Maple.

Habit. A handsome tree, with a height of 12-18 meters (40-60 ft.), and a trunk diameter of 30-60 cm., having a round, spreading crown of stout branches, resembling *Acer saccharum*. Twigs coarse.

Leaves. Opposite, simple, 10-18 cm. broad, and almost as long; thin; 5-7-lobed at maturity, lobes remotely coarse-toothed with the teeth drawn out into filamentous points, separated by rounded, scallop-like sinuses; glabrous, bright green both sides, turning pale yellow in autumn; petioles long, slender, exuding a milky juice when cut.

Flowers. May, before or with the leaves; large, yellow-green, in erect, short, flat racemes; sepals 5; petals 5; stamens 8.

Fruit. Ripens in autumn and germinates the following spring; pendent on long stalks; large, glabrous, paired samaras, with wings 5 cm. long, diverging by nearly 180 degrees.

Twigs in Winter. Twigs moderate, yellow-green, red or dull red-brown; terminal bud about 6 mm. long, broad, short-stalked, with bud scales strongly keeled; lateral buds small, appressed; buds exuding a milky juice when cut. Leaf scars U-shaped; bundle scars 3; stipule scars lacking.

Bark and Wood. Bark greenish to light brown, shiny; trunk dark gray, becoming closely fissured, not scaly. Wood moderately heavy, hard, close-grained, whitish or brownish, with white sapwood.

Distribution in the State. Native of Europe, but frequently planted in at least the eastern third to half of Kansas.

Habitat. Prefers rich, well-drained soil, but its excellent development both of deep roots and widely spreading roots enable it to be a very thrifty tree.

Remarks. Probably the most desirable maple to use in planting where it will grow. In its different horticultural varieties a handsome tree at any season.

Acer ginnala Maxim, a small tree, with green under surfaces of its 3-lobed leaves, and fruit wings nearly parallel; and

Acer tataricum L., a shrub (or small tree), with fruit wings nearly parallel, but with its leaves green on both surfaces, but little if at all lobed.

These last two are found in plantings, as are possibly still other maples.

FIG. 185.—*Acer platanoides.*

1. Winter twig, x 1.
2. Leaf, x ½.
3. Raceme of staminate flowers, x ½.
4. Staminate flower, enlarged.
5. Raceme of pistillate flowers, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

(From Otis: Michigan Trees.)

JUGLANDACEÆ.

Juglans cinerea L.

Butternut.

Habit. A medium-sized tree 12-18 meters (40-60 ft.) high, with a short trunk 60-80 cm. in diameter; forming a wide-spreading crown of large horizontal branches and stout, stiff branchlets.

Leaves. Alternate, compound, 35-70 cm. long. Leaflets 11-17, 5-10 cm. long and one-half as broad; sessile, except the terminal; oblong-lanceolate; finely serrate; thin; yellow-green and rugose above, pale and soft-pubescent beneath; turning yellow or brown and falling early in the autumn. Petioles stout, hairy.

Flowers. May, with the leaves; monœcious; the staminate in cylindrical, greenish, drooping catkins 8-13 cm. long; calyx 6-lobed, borne on a hairy bract; corolla 0; stamens 8-12, with brown anthers; the pistillate solitary or several on a common peduncle, about 8 mm. long, their bracts and bractlets sticky-hairy; calyx 4-lobed, hairy; corolla 0; styles 2; stigmas 2, fringed, spreading, bright red.

Fruit. October; about 6 cm. long, cylindrical, pointed, greenish, sticky-downy, solitary or borne in drooping clusters of 3-5; nuts prominently 4-ribbed at the sutures, with rough shells, inclosing a sweet, but oily kernel; edible.

Twigs in Winter. Medium stout. Pith moderate, chocolate-brown, chambered. Terminal bud 12-18 mm. long, obliquely blunt, somewhat flattened, hairy, brown; lateral buds smaller, rounded, in groups of 2-4, scales inconspicuous. Leaf scars shield-shaped or somewhat 3-lobed, large, raised; bundle scars in 3 compound groups; stipule scars lacking.

Bark and Wood. Twigs orange-brown or bright green, rusty pubescent, becoming smooth and light gray; gray and smoothish on young trunks, becoming brown on old trunks, narrow-ridged, with wide furrows. Wood light, soft, weak, coarse-grained, light brown, with thin, lighter-colored sapwood.

Distribution in the State. Supposed to occur in the extreme northeastern part of the state, and occasionally planted elsewhere.

Habitat. Prefers low, rich woods along rivers.

Remarks. Credited to eastern Kansas, but no authenticating specimens are in the K. S. A. C. herbarium.

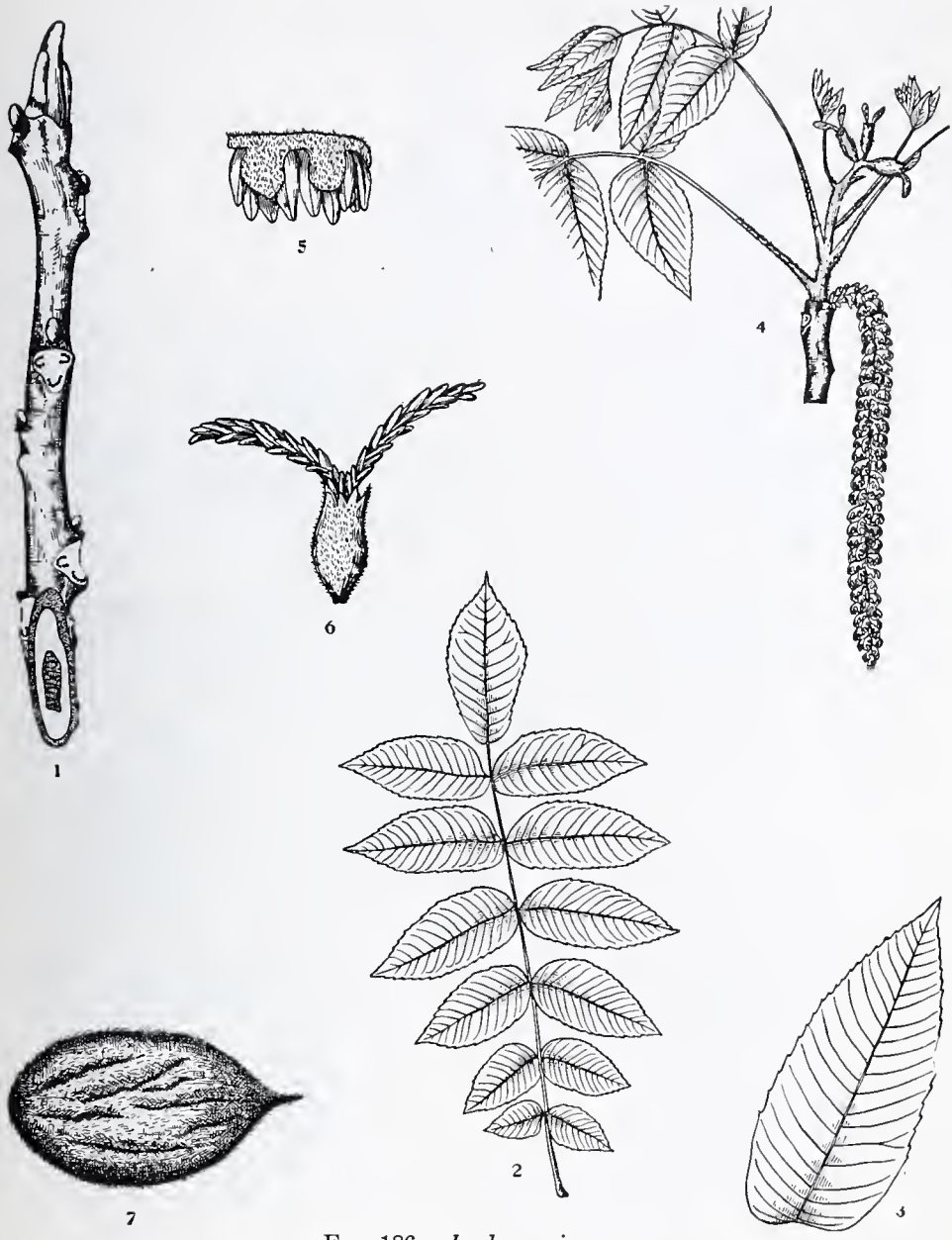

FIG. 186.—*Juglans cinerea.*

1. Winter twig, x 1.
2. Leaf, x ⅙.
3. Leaflet, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

(From Otis: Michigan Trees.)

JUGLANDACEÆ.

Juglans nigra L.

Black Walnut.

Habit. A large tree 15-25 or more meters (50-83 ft.) high, with a massive trunk 0.5 to 1.5 meters in diameter; forming an open, capacious crown of heavy branches and coarse twigs; rooted deeply.

Leaves. Alternate, compound, 30-60 cm. long. Leaflets 13-23, the terminal often lacking, 5-10 cm. long and one-half as broad; ovate-lanceolate, taper-pointed; sharp-serrate; thin; yellow-green and glabrous above, lighter and soft-pubescent beneath. Petioles stout, pubescent. Foliage aromatic when bruised, turning bright yellow and falling early in the autumn.

Flowers. May, with the leaves; monœcious; the staminate in cylindrical, greenish, drooping catkins 7-13 cm. long; calyx 6-lobed, borne on a hairy bract; corolla 0; stamens numerous, with purple anthers; the pistillate solitary or several on a common peduncle, about 6 mm. long, their bracts and bractlets hairy; calyx 4-lobed, pubescent; corolla 0; styles and stigmas 2.

Fruit. October; globose, 4-5 cm. in diameter, smooth, not viscid; solitary or borne in clusters of 2-3; nuts with irregularly furrowed shell, inclosing an oily, sweet, deeply lobed edible kernel.

Twigs in Winter. Rather stout, more or less fluted. Pith moderate, brown, angular, chambered with rather close thin plates. Buds moderate with several scales, superposed; the terminal larger (8 mm.), ovoid, obliquely blunt, slightly flattened, silky-tomentose. Leaf scars shield-shaped or somewhat 3-lobed, large, raised; bundle scars in 3 compound groups; stipule scars lacking.

Bark and Wood. Bark brownish and hairy, becoming darker and smooth; thick, brownish or blackish on the trunk and deeply furrowed by broad, rounded ridges. Wood heavy, hard, strong, close-grained, very durable in contact with the soil, rich dark brown, with thin, lighter colored sapwood.

Distribution in the State. In most of the counties in the eastern two-thirds of the state.

Habitat. Prefers rich bottom lands and fertile hillsides.

Remarks. A valuable lumber tree, if grown under suitable conditions. Valuable also for ornament and for the nuts.

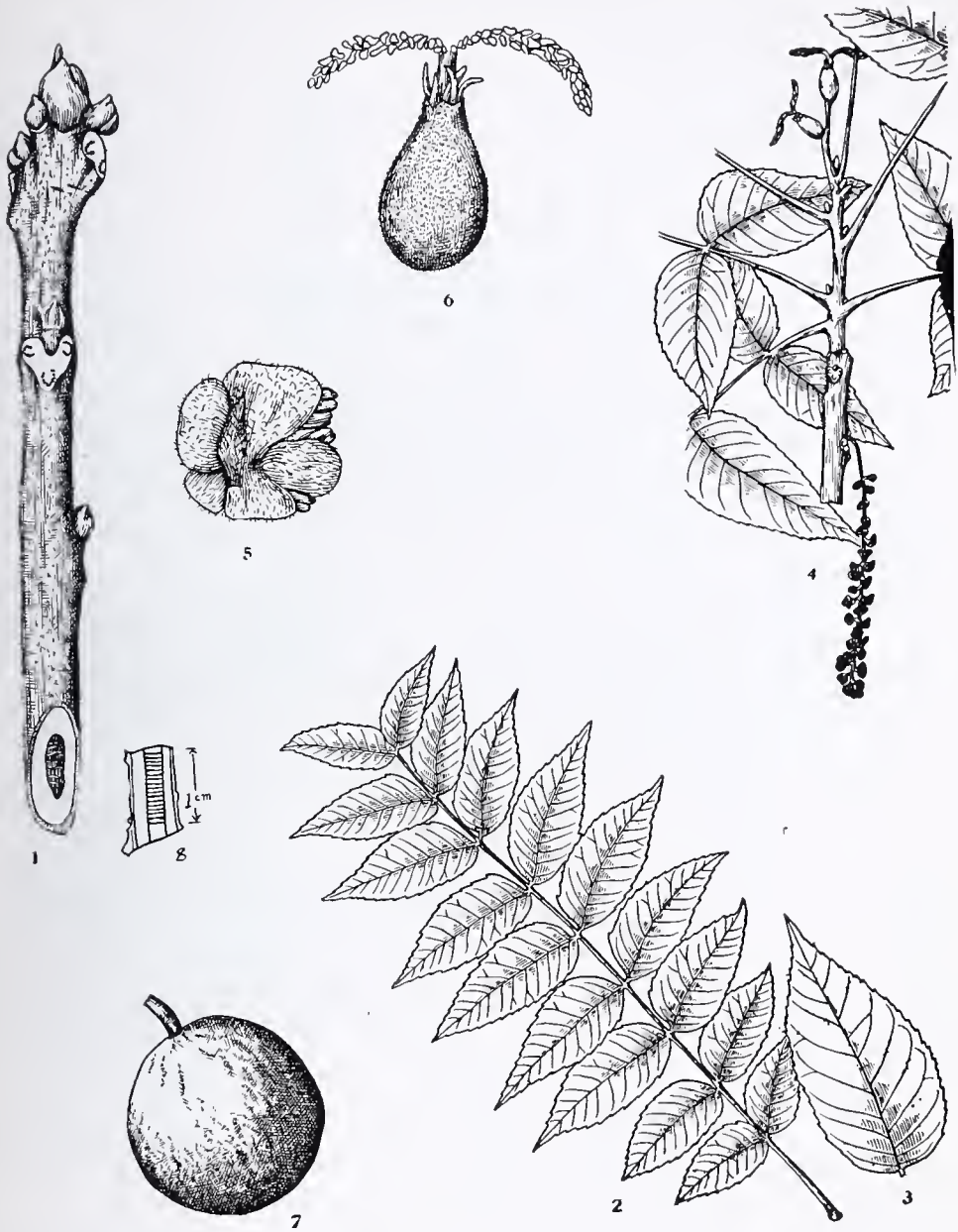

FIG. 187.—*Juglans nigra.*

1. Winter twig, x 1.
2. Leaf, x ⅙.
3. Leaflet, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, back view, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x ½.
8. Longitudinal section of portion of twig, showing chambers in the pith. (Original.)

(From Otis: Michigan Trees.)

JUGLANDACEÆ.

Hicoria pecan (Marsh.) Britton.

(*Carya olivæformis* Nutt. *Carya illinoensis* [Wang.] K. Koch.)

Pecan.

Habit. Tall, straight tree up to 20 or more meters (66 ft.) high and a slender tapering trunk, which may become a meter or more in diameter at the base.

Leaves. Alternate, compound 30-50 cm. long. Leaflets 11-15, 10-18 cm. long, oblong-lanceolate or ovate-lanceolate, short-stalked, tapering to a point, inequilateral, finely serrate, thick and firm, pubescent while young but becoming nearly glabrous.

Flowers. April-May, after the leaves; monœcious; the staminate in pendulous, ternate catkins, 13-15 cm. long, sessile or nearly so in the axils of leaf scars near the end of twigs of the preceding season or sometimes on the young shoots; bract of the staminate calyx linear, much longer than the broadly oblong lateral lobes; the pistillate oblong, narrowed at the ends, slightly 4-angled and coated with yellow, scurfy pubescence.

Fruit. October, oblong-cylindric, 3-6 cm. long; husk thin, 4-valved; nut smooth, oblong, thin-shelled, pointed, 2-celled at base, dissepiments thin, astringent; seed delicious.

Twigs in Winter. Twigs moderate, terete. Pith moderate, angled. Terminal bud 12 mm. long, acute, compressed, covered with clusters of bright yellow articulate hairs and pale tomentum; lateral buds small, ovate; bud scales in pairs, scarcely glandular. Leaf scars shield-shaped, large; bundle scars numerous in 3-4 groups or scattered; stipule scars lacking.

Bark and Wood. Bark of twigs more or less downy, becoming glabrous and darker, roughened on the trunk. Wood hard, brittle, light brown, with thin whitish sapwood.

Distribution in the State. Southeastern corner as far north as Miami county and as far west as Cowley county.

Habitat. Usually preferring the low, bottom lands of the largest streams, though found to some extent on uplands.

Remarks. Furnishing the pecan nuts of commerce.

FIG. 188.—*Hicoria pecan.*

1. Winter twigs, x 1.
2. Young twig, showing early pubescence, x 1.
3. Leaf, x ⅙.
4. Leaflet, x ½.
5. Twig, with staminate catkins, x ¼.

5*a*. Staminate flower from above, enlarged.

5*b*. Staminate flower and bract from beneath, enlarged.

6. Twig, with pistillate inflorescence, x ½.

6*a*. Pistillate flower, enlarged.

6*b*. Twig, with young fruits, x ½.

7. Fruit, x ½.
8. Nut, x ½.
9. Cross section of nut, x ½.

(Original.)

JUGLANDACEÆ.

Hicoria cordiformis (Wang.) Britton.

(*Carya cordiformis* [Wang.] K. Koch., *H. minima.*)

Bitternut Hickory, Swamp Hickory, Yellowbud Hickory.

Habit. A tall, slender tree 15-24 meters (50-80 ft.) or more high, with a trunk diameter of 30-75 cm.; forming a broad crown of slender, stiff, upright branches, often widest near the top.

Leaves. Alternate, compound, the upper 15-25 cm. long and one-fourth as broad; sessile, except the terminal; lanceolate to oblong-lanceolate, often more or less unequal at the base, long-pointed; coarsely serrate; thin and firm; glabrous, bright green above, paler and more or less downy beneath. Petioles slender, hairy. Foliage fragrant when crushed, turning bright yellow in the autumn.

Flowers. May, after the leaves; monœcious; the staminate slightly pubescent, in pendulous, ternate catkins 8-10 cm. long, on a common peduncle about 2.5 cm. long; scales 3-lobed, hairy; stamens 4, with bearded, yellow anthers; the pistillate in 2-5 flowered spikes 12 mm. long, scurfy-tomentose; calyx 4-lobed, pubescent; corolla 0; stigmas 2, greenish.

Fruit. October; obovate to globular, about 2.5 cm. long, coated with yellow, scurfy pubescence, with very thin husk splitting half-way to the base, with sutures more or less winged at the top; nut quite smooth, with thin shell and small, fleshy, bitter kernel.

Twigs in Winter. Twigs moderate, terete. Pith moderate, angled. Terminal bud 8-18 mm. long, long pointed, flattish, sulphur yellow, granular; lateral buds much smaller, somewhat 4-angled; bud scales in pairs. Leaf scars shield-shaped, large; bundle scars numerous, in 3 or more groups; stipule scars lacking.

Bark and Wood. Bark of twigs greenish and more or less downy, becoming brownish, and finally grayish; gray, close, smooth on the trunk, often reticulately ridged, but rarely broken into plates. Wood heavy, very hard, strong, tough, close-grained, elastic, durable, dark brown, with thick, lighter colored sapwood; an excellent fuel.

Distribution in the State. Eastern third, probably a little further west; the commonest hickory.

Habitat. Prefers a rich, loamy or gravelly soil; low, wet woods; along the borders of streams; but also found on high, dry uplands.

Remarks. The most rapid growing of the hickories. Difficult to transplant as are the others also.

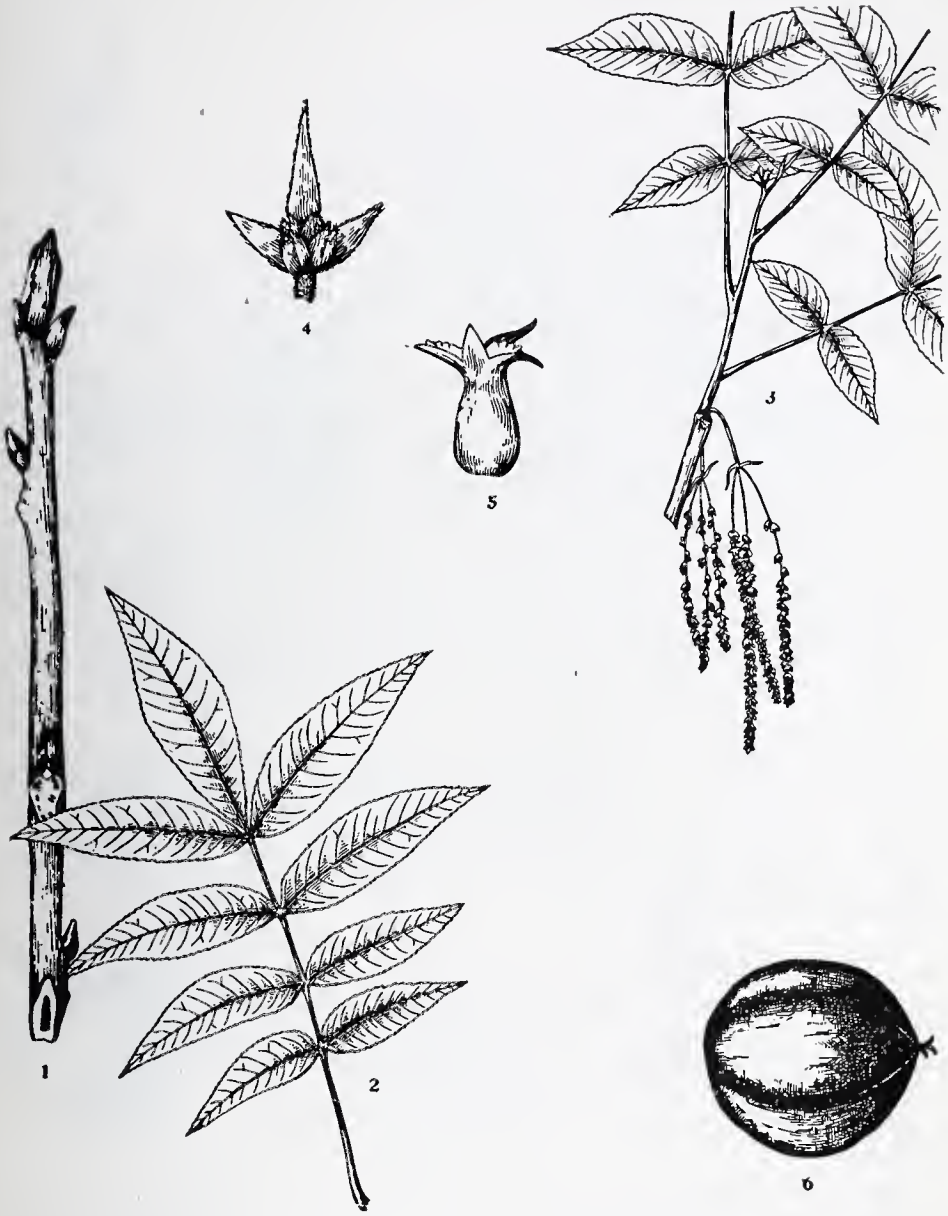

FIG. 189.—*Hicoria cordiformis.*

1. Winter twig, x 1.
2. Leaf, x ⅓.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

(From Otis: Michigan Trees.)

JUGLANDACEÆ.

Hicoria ovata (Mill.) Britton.

(*Carya ovata* [Mill.] K. Koch.)

Shagbark Hickory, Shellbark Hickory.

Habit. A tree 15-25 meters (50-83 ft.) high, with a slender, columnar trunk 30-60 (or sometimes 90 cm.) in diameter; forming a narrow, somewhat open crown of stout, slightly spreading limbs and stout branchlets.

Leaves. Alternate, compound, 20-35 cm. long. Leaflets usually 5, the upper 13-18 cm. long and 5 to 7.5 cm. broad; sessile, except the terminal; obovate to oblong-lanceolate; finely serrate; thick and firm; glabrous; dark green above, paler beneath and glabrous or puberulous. Petioles stout, enlarged at the base, smooth or hairy. Foliage fragrant when crushed.

Flowers. May, after the leaves; monœcious; the staminate hairy, greenish, in pendulous, ternate catkins 10-13 cm. long, on a common peduncle about 2.5 cm. long; scales 3-parted, bristle-tipped; stamens 4, with yellow anthers; the pistillate in 2-5-flowered spikes, 8 mm. long, brown-tomentose; calyx 4-lobed; hairy; corolla 0; stigmas 2, large, fringed.

Fruit. October; globular, 2.5 to 5 cm. long, with thick, dry, light brown, 4-valved husk separating completely; nut usually 4-ridged, with thick, hard shell and large, sweet, edible kernel.

Twigs in Winter. Twigs moderate, terete. Pith moderate, angled, continuous or broken at the nodes. Terminal bud 12-18 mm. long, broadly ovoid, obtuse, dark brown, pale tomentose or nearly glabrous, its inner scales enlarging to 5-7 cm. in length in the spring growth; yellowish-green, tinged with red, downy and remaining until the leaves are about half grown. Leaf scars shield-shaped, large, low; bundle scars numerous in 3 or 4 more or less definite groups; stipule scars lacking.

Bark and Wood. Bark of twigs brownish, more or less downy, becoming smooth and grayish; thick and grayish on old trunks, separating into thick strips 30-100 cm. long, free at one or both ends, giving a characteristic shaggy appearance. Wood heavy, very hard and strong, tough, close-grained, elastic, light brown, with thin, whitish sapwood, used in the manufacture of agricultural implements, tool handles, barrels, tubs and for fuel.

Distribution in the State. Eastern fourth of the state, but also west into Riley county.

Habitat. Prefers light, well drained, loamy soil; low hillsides; river banks.

Remarks. A valuable tree for the wood, the nuts, fuel and for ornament.

FIG. 190.—*Hicoria ovata.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ⅓.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

(From Otis: Michigan Trees.)

JUGLANDACEÆ.

Hicoria laciniosa (Michx. f.) Sarg.

(*Carya laciniosa* [Michx. f.] Loud.)

Bigleaf Shagbark Hickory, King Nut, Shellbark Hickory.

Habit. A tree 18-25 meters (60-83 ft.) or more high, with a tall, slender trunk 60-100 cm. in diameter; forming a narrow, oblong crown of small spreading branches.

Leaves. Alternate, compound, 30-60 cm. long. Leaflets usually 7, the upper 13-23 cm. long, 8-13 cm. broad, larger than the lowest pair; sessile or short-stalked; oblong-lanceolate to obovate, taper-pointed; finely serrate; thick and firm; shining, dark green above, paler and soft-pubescent beneath. Petioles stout, glabrous or pubescent, often persistent on the branches during the winter. Foliage fragrant when crushed.

Flowers. May, after the leaves; monœcious; the staminate in pendulous, ternate catkins 10-18 cm. long, slender, yellow-green, on common peduncles 2.5 cm. long, scales 3-lobed, tomentose; stamens 4, with yellow, hairy anthers; the pistillate in crowded, 2-5-flowered spikes, tomentose; calyx 3-toothed, hairy; corolla 0; stigmas 2, light green.

Fruit. October; oblong to subglobose, 4.5 to 6.5 cm. long, with very thick, woody husk, splitting to the base; nut 4-6-ridged, with thick, hard shell and large, sweet kernel.

Twigs in Winter. Twigs moderate, terete. Pith moderate, angled. Terminal buds about 25 mm. long, ovoid, obtuse, dark brown, puberulous, becoming greatly enlarged with the growth in spring. Leaf scars shield-shaped, large, low; bundle scars numerous in 3 or 4 more or less definite groups; stipule scars lacking.

Bark and Wood. Bark of twigs orange and more or less pubescent, becoming darker in the first winter, and finally grayish; on the trunk 2.5 to 5 cm. thick, light gray, separating into broad, thick plates 0.9 to 1.2 meters long, persistent on the trunk for many years. Wood heavy, very hard, strong, tough, close-grained, very elastic, dark brown, with thin, whitish sapwood, useful the same as the shagbark hickory.

Distribution in the State. The southeastern part of the state to at least Kansas City on the north and Cowley county on the west.

Habitat. Rich bottomlands.

Remarks. Similar to the shagbark in most uses, except that the nuts, although much larger, are not so valuable.

FIG. 191.—*Hicoria laciniosa.*

1. Winter twig, x ½.
2. Leaf, x ¼.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x ½.

(From Otis: Michigan Trees.)

JUGLANDACEÆ.

Hicoria alba (L.) Britton.

(*Carya alba* [L.] K. Koch.)

Mockernut, White-heart Hickory.

Habit. A tree 15-20 meters (50-66 ft.) high, with a trunk diameter of 30-75 cm.; forming a wide crown of strong, upright branches and stout branchlets.

Leaves. Alternate, compound, 20-30 cm. long. Leaflets usually 5-7, sometimes 9, the upper 13-20 cm. long, 5-8 cm. broad; oblong- to obovate-lanceolate; minutely or sometimes coarsely serrate; thick and firm; shiny, dark yellow-green above, paler and more or less pubescent beneath. Petioles pubescent. Foliage fragrant when crushed.

Flowers. May, after the leaves; monœcious; the staminate in pendulous, ternate catkins 10-13 cm. long, slender, green, hairy; scales 3-lobed, hairy; stamens 4-5, with red anthers; the pistillate in crowded, 2-5-flowered, tomentose spikes; calyx toothed, hairy; corolla 0; stigmas 2, hairy.

Fruit. October; globose to globose-oblong, 4-5 cm. long, with thick husk splitting nearly to the base; nut 4-ridged, red-brown, with very thick, hard shell and small, sweet kernel.

Twigs in Winter. Twigs moderate, terete. Pith moderate, angled. Terminal buds 12-18 mm. long, broadly ovoid, red-brown, pilose, the outermost scales fall in early autumn, the inner scales enlarging greatly in spring growth. Leaf scars shield-shaped, large, low; bundle scars numerous in 3 or 4 more or less definite groups; stipule scars lacking.

Bark and Wood. Bark of twigs at first brown-tomentose, becoming smooth and grayish; on the trunk thick, hard, grayish, slightly ridged by shallow, irregular fissures, becoming rugged on very old trunks. Wood very heavy, hard, strong, rough, close-grained, elastic, dark brown, with thick, whitish sapwood.

Distribution in the State. Wyandotte county and southward.

Habitat. Prefers rich, well-drained soil, as uplands and bluffs, but grows well in various situations if they are not too wet.

Remarks. The name comes from the surprisingly small kernels in nuts of promising size. Useful similarly to other hickories.

FIG. 192.—*Hicoria alba.*

1. Winter twig, x 1.
2. Leaf, x ⅓.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x ½.

(From Otis: Michigan Trees.)

JUGLANDACEÆ.

Hicoria glabra (Mill.) Britton.

(*Carya glabra* [Mill.] Spach.)

Pignut Hickory.

Habit. A tree usually 15-20 meters (50-66 ft.) high, with a trunk diameter of 30-100 cm.; forming a low, rather narrow, open crown of slender, often contorted branches.

Leaves. Alternate, compound, 20-30 cm. long. Leaflets usually 5-7, the upper 8-15 cm. long, 5 to 6.5 cm. broad; subsessile, except the terminal; oblong to obovate-lanceolate, taper-pointed; sharply serrate; thick and firm; glabrous, dark yellow-green above, paler beneath. Petioles long, slender, glabrous or pubescent. Foliage fragrant when crushed.

Flowers. May-June, after the leaves; monœcious; the staminate in pendulous, ternate catkins 8-18 cm. long, slender, yellow-green, tomentose; scales 3-lobed, nearly glabrous; stamens 4, with orange anthers; the pistillate in crowded, 2-5-flowered spikes, 6 mm. long; calyx 4-toothed, hairy; corolla 0; stigmas 2, yellow.

Fruit. October; variable in size and shape, 4-5 cm. long, with thin husk splitting half way and sometimes nearly to the base; nut obscurely 4-ridged, with thin or thick hard shell, and small sweet or slightly bitter kernel which is hard to remove.

Twigs in Winter. Twigs moderate, terete. Pith moderate, angled. Terminal bud 6-12 mm. long, dome shaped, greenish or grayish, smooth or finely downy. Leaf scars large, somewhat 3-lobed; bundle scars numerous in 3 or 4 groups; stipule scars lacking.

Bark and Wood. Bark of twigs greenish, nearly glabrous, becoming reddish, and finally grayish; thick, hard and grayish on the trunk, with a firm, close surface divided by small fissures and sometimes broken into plates. Wood heavy, hard, very strong, tough, close-grained, elastic, dark brown, with thick, whitish sapwood.

Distribution in the State. Recorded in Cherokee and Wyandotte counties.

Habitat. Prefers deep, rich loam, but grows in any well-drained soil; dry ridges and hillsides.

FIG. 193.—*Hicoria glabra.*

1. Winter twig, x 1.
2. Leaf, x ¼.
3. Flowering branchlet, x 1.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x ⅔.

(From Otis: Michigan Trees.)

BETULACEÆ.

Ostrya virginiana (Mill.) Willd.

Hop Hornbeam, Ironwood.

Habit. A small tree usually less than 8 meters (26 ft.) high, with a trunk diameter of 20-30 cm.; forming a broad, rounded crown of many long, slender branches and a slender, stiff spray.

Leaves. Alternate, simple, 5-10 cm. long, about one-half as broad; oblong-ovate; more or less unsymmetrical, sharply doubly serrate; thin and very tough; dull, dark green above, paler and more or less pubescent beneath; petioles short, slender, pubescent.

Flowers. April-May, with the leaves; monœcious; the staminate in drooping, cylindrical catkins from wood of the previous season, usually in threes; stamens 3-14, crowded on a hairy receptacle; the pistillate in erect, lax catkins on the season's shoots, usually in pairs, each flower inclosed in a hairy, sac-like involucre.

Fruit. September; strobiles, resembling clusters of hops, 2.5 to 5 cm. long, borne on slender, hairy stems; nuts small and flat, inclosed by saclike involucres.

Twigs in Winter. Twigs slender, zigzag, terete, usually finely pubescent. Pith small, roundish, continuous, pale. Terminal bud lacking; lateral buds 3-6 mm. long, reddish-brown, solitary, or exceptionally superposed, sessile, ovoid, oblique, with half a dozen spirally placed striate scales. Leaf scars 2-ranked, somewhat raised, crescent-shaped or half-elliptical, small; bundle scars 3; stipule scars unequal, elongated. Catkins often present.

Bark and Wood. Bark of twigs at first light green, becoming shining, red-brown, and finally dull dark brown; thin, gray-brown on the trunk, very narrowly and longitudinally ridged. Wood heavy, very strong and hard, rough, close-grained, durable, light red-brown, with thick, whitish sapwood.

Distribution in the State. Parts of the eastern third of the state, but particularly in the Kansas River valley.

Habitat. Usually found in dry, cool, shaded, gravelly slopes and ridges.

Remarks. Very slow growing.

Carpinus caroliniana Walter, the Blue Beech or Water Beech, rare in eastern Kansas, is a low, bushy tree or shrub, with short, usually fluted trunk, dark bluish-gray, often mottled with lighter or darker patches; leaves about one-half as broad as long; fruit in loose terminal strobiles, involucre halberd-shape, inclosing a small, ovate, brownish nut.

FIG. 194.—*Ostrya virginiana.*

1. Winter twig, x ½.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

(From Otis; Michigan Trees.)

BETULACEÆ.

Betula pendula Roth.

Birch, Weeping Birch.

Habit. A tree up to 18 meters (60 ft.) in height, with slender, usually pendulous branches.

Leaves. Alternate; simple; 2-7 cm. long; rhombic-ovate; acuminate; wedge-shaped or truncate at base; doubly serrate, in some varieties lobed; glutinous when young but glabrous and shining at maturity; petioles slender, about 2.5 cm. long.

Flowers. April, before the leaves; monœcious; the staminate catkins clustered or in pairs, 7-10 cm. long, pendulous, slender; pistillate catkins about 2.5 cm. long, cylindrical, pendulous.

Fruit. Late summer; nut with wings 1.5 to 2.5 times as broad as its body, on 3-lobed scales, in a cylindrical strobilus 2.5 cm. long on a slender peduncle.

Twigs in Winter. Twigs slender, usually zigzag, terete, reddish-brown, frequently developing as dwarfed shoots or spurs. Pith minute, a trifle angled, continuous greenish. Terminal bud usually absent except on spurs; lateral buds moderate, solitary, narrowly ovoid, flattish, with 2 or 3 exposed scales, usually divergent. Leaf scars more or less 2-ranked, half-elliptical, small; bundle scars 3, sometimes indistinct; stipule scars narrow.

Bark and Wood. At first reddish-brown or brown, becoming in a few years white, readily peeling off in papery layers, finally becoming furrowed and almost black near the ground. Wood hard, strong, reddish-brown.

Distribution in the State. Native of Europe, etc., but freely planted.

Habitat. A wide variety of upland conditions.

Remarks. The white bark and delicate pendulous branches make it an attractive ornament at all seasons.

FIG. 195.—*Betula pendula.*

1. Winter twig, x ½.
2, 3. Portions of winter twigs, x 1½.
4. Leaf, x 1.
5. Twig with staminate inflorescence, reduced.
6. Fruiting twig, x 1.
7. Fruiting scale, x 2.
8. Fruiting scale from beneath, x 2.
9. Wing variation in seeds, x 2.

(Original.)

BETULACEÆ.

Betula nigra L.

River Birch, Red Birch.

Habit. A slender tree, probably not exceeding 18 meters (60 ft.) in height. nor a trunk diameter of 60 cm. in the state. In age a long branchless trunk with a broad open crown, with a few large ascending branches and a slender flexible spray.

Leaves. Alternate; simple; 4-8 cm. long; rhombic-ovate; apex acute or obtuse; irregularly serrate or somewhat lobed; base cuneate; tomentose beneath at first and sometimes also at maturity, dark green above and pale beneath; petioles 6-17 mm. long.

Flowers. April-May, before the leaves; monœcious; staminate catkins clustered in twos or threes, 6-9 cm. long, slender, pendent; pistillate catkins oblong-cylindric, spreading, peduncled, 2.5 to 5 cm. long.

Fruit. Late summer or autumn; nut broadly obovate, wider than its wings, pubescent at its base; fruiting bracts tomentose, about equally 3-lobed, 6-11 mm. long; fruiting catkin 10-13 mm. in diameter.

Twigs in Winter. Twigs slender, usually zigzag, terete, reddish, frequently developing as dwarf shoots so as to make the lateral buds appear stalked. Pith minute, somewhat 3-sided, continuous, green. Terminal bud usually absent except on side spurs; lateral buds moderate, solitary, narrowly ovoid, flattish with 2 or 3 exposed scales, usually divergent. Leaf scars more or less 2-ranked, half-elliptical, small; bundle scars 3, sometimes indistinct; stipule scars narrow.

Bark and Wood. Bark reddish or greenish brown, peeling in very thin layers; of the twigs pubescent but becoming glabrous. Wood hard, strong, brown.

Distribution in the State. From Crawford to Chautauqua counties in the southeastern corner of the state. Planted elsewhere.

Habitat. Along streams and along lakes.

Remarks. As this tree ranges both north and south of Kansas it might well be expected in more places than it has been yet found.

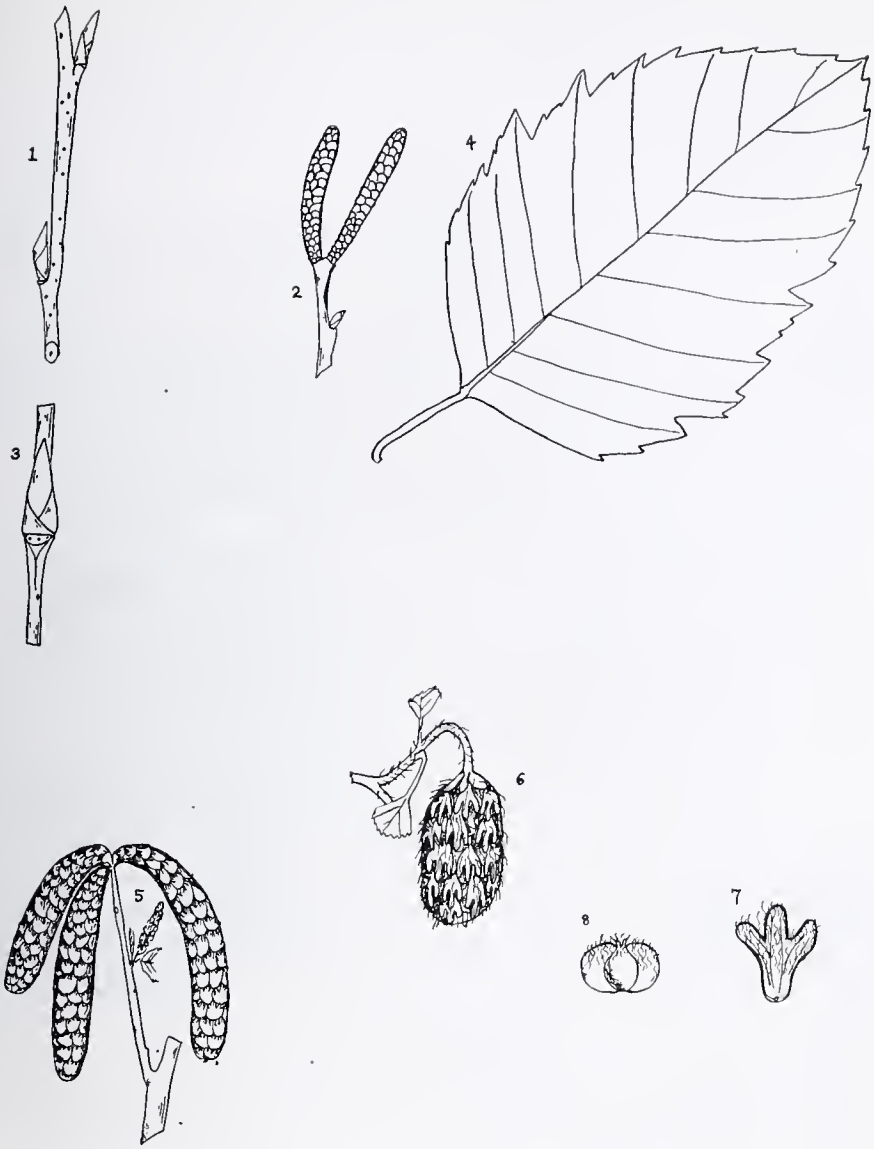

FIG. 196.—*Betula nigra.*

1. Top view of winter twig, x 1.
2. Winter twig, x 1.
3. Side view of winter twig, x 1½.
4. Leaf, x 1.
5. Twig, showing three staminate catkins and one pistillate catkin, x 1.
6. Fruiting branch, x 1.
7. Fruiting scale, x 1½.
8. Seed, x 1½.

(Original.)

FAGACEÆ.

Quercus maxima Ashe.

(*Quercus rubra, Quercus borealis maxima.*)

Red Oak.

Habit. A large tree 20-25 meters (66-83 ft.) high, with a trunk diameter of 60-120 cm.; forming a broad, rounded crown of a few large, wide-spreading branches and slender branchlets.

Leaves. Alternate, simple, 13-23 cm. long, 10-15 cm. broad; oval to obovate; 5-11-lobed with coarse-toothed, bristle-tipped lobes tapering from broad bases and wide, oblique, rounded sinuses; thin and firm; dull dark green above, paler beneath; petioles stout, 2.5 to 5 cm. long.

Flowers. May, when the leaves are half grown; monœcious; the staminate in hairy catkins 10-13 cm. long; the pistillate on short, glabrous peduncles, singly or in pairs in the axils of the immature leaves; calyx 4-5-lobed, greenish; corolla 0; stamens 4-5, with yellow anthers; stigmas long, spreading, green.

Fruit. Autumn of second year; sessile or short-stalked acorns; cup shallow saucer-shaped, inclosing only the base of the nut; scales closely appressed, more or less glossy, puberulous, bright red-brown; nut oblong-ovoid with a broad base, about 2.5 cm. long, red-brown; kernel white, or pinkish, very bitter.

Twigs in Winter. Twigs moderate, fluted. Pith moderate, 5-angled, continuous. Terminal bud 3-6 mm. long, ovoid, acute, light brown, smooth; lateral buds clustered towards the tip, all with numerous scales. Leaf scars half-round, somewhat elevated; bundle scars 10 or more; stipule scars small.

Bark and Wood. Bark of twigs shiny, green, becoming reddish, finally dark brown; old trunks darker, shallowly fissured into thin, firm, broad ridges; inner bark light red, rich in tannic acid. Wood heavy, hard, strong, coarse-grained, light red-brown, liable to check badly in drying, with thin, darker colored sapwood.

Distribution in the State. Eastern third of the state.

Habitat. Prefers rich, moist loam; glacial drift; stream-banks, but grows well in all well-drained soils.

Remarks. An important lumber and ornamental tree.

FIG. 197.—*Quercus maxima.*

1. Winter twig, x 1.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

(From Otis: Michigan Trees.)

FAGACEÆ.

Quercus palustris Du Roi.

Pin Oak, Swamp Oak.

Habit. A medium-sized tree 12-15 meters (40-50 ft.) or more high, with a trunk diameter of 30-60 cm. or more; forming an oblong or pyramidal crown of many upright, spreading branches, the lowermost drooping nearly to the ground.

Leaves. Alternate, simple, 10-15 cm. long, 5-10 cm. broad; obovate to ovate; 5-7-lobed by deep, wide, rounded sinuses, the lobes few-toothed, bristle-tipped; pale reddish-green as they unfold from the bud, shining and hairy above, covered with whitish scurfy down beneath, becoming thin and firm; very shining, dark green above, paler beneath; turning deep scarlet in autumn and often remaining on until spring; petioles slender, 2-5 cm. long.

Flowers. May, with the leaves; monœcious; the staminate in hairy catkins 5-8 cm. long; the pistillate tomentose, borne on short, tomentose peduncles in the axils of the young leaves; calyx 4-5-lobed, hairy; corolla 0; stamens 4-5, with yellow anthers; stigmas recurved, bright red.

Fruit. Autumn of second season; sessile or short-stalked acorns; cup saucer-shaped with more or less hairy scales closely appressed, dark red-brown, inclosing only the base of the nut; nut nearly hemispherical, about 12 mm. in diameter, light brown; kernel bitter.

Twigs in Winter. Twigs rather slender, fluted. Pith moderate, 5-angled, continuous. Terminal bud about 3 mm. long, ovoid or conical, acute, light brown, smooth or somewhat hairy towards the tip; lateral buds clustered towards the tip, with numerous scales. Leaf scars approximately half-round, somewhat elevated; bundle scars 10 or more; stipule scars small.

Bark and Wood. Bark of twigs dark red and tomentose at first, becoming shining, green, finally gray-brown; thick, gray-brown and smoothish or with small, closely appressed scales on the trunk. Wood heavy, hard, strong, coarse-grained, light brown, with thin, darker colored sapwood.

Distribution in the State. Found westward to Montgomery and Greenwood counties, and north to Franklin.

Habitat. Prefers moist, rich soil; river bottoms; borders of swamps.

Remarks. Usually considered the finest American oak for street and ornamental planting, grows rapidly and can be transplanted. The horizontal branches are very characteristic.

Quercus shumardii Buckley, the Shumard Red Oak, is credited to Kansas in Sudworth's "Check List." It has clay-colored, glabrous buds and ovoid acorns.

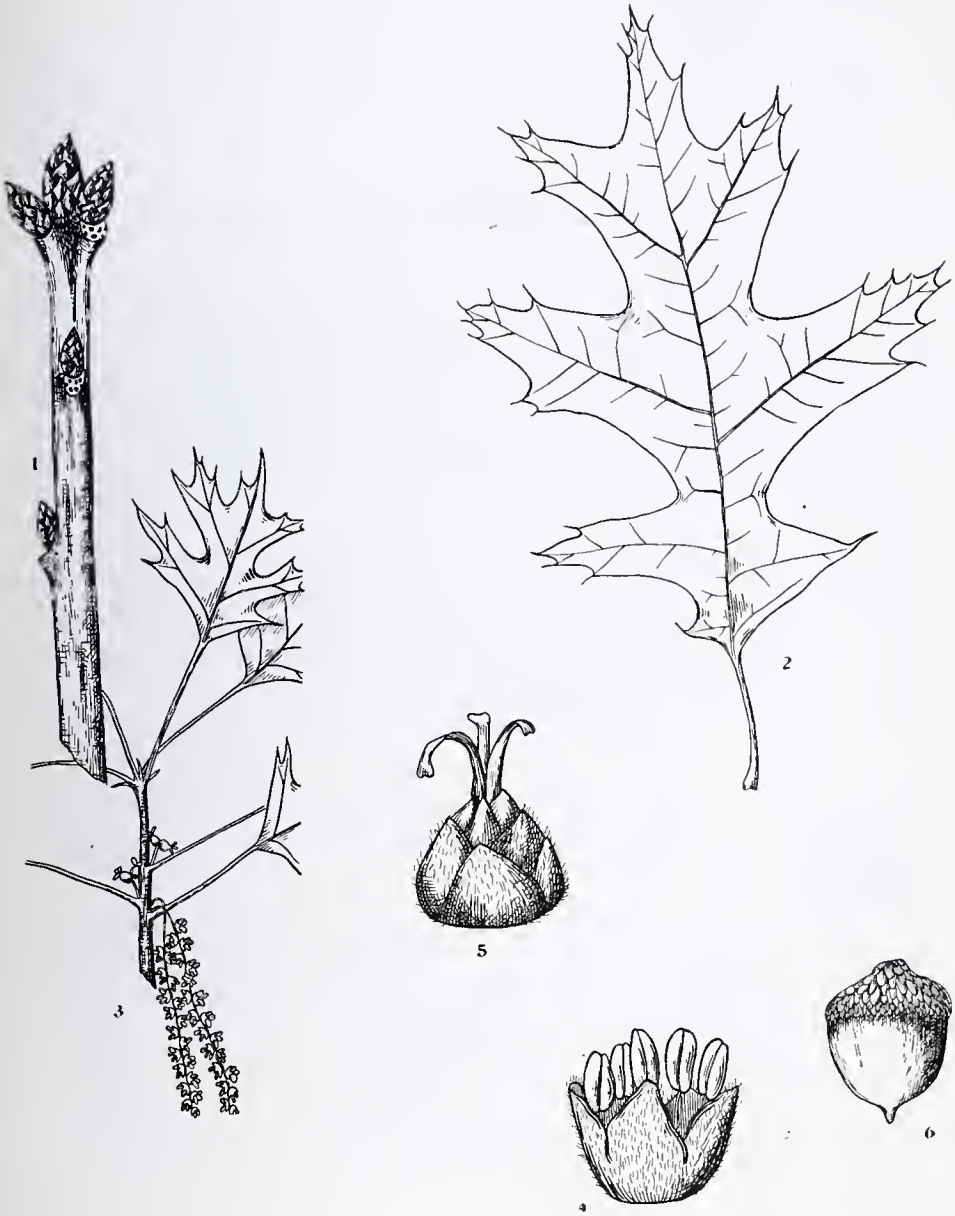

FIG. 198.—*Quercus palustris.*

1. Winter twig, x 3.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

(From Otis: Michigan Trees.)

FAGACEÆ.

Quercus velutina Lam.

Black Oak.

Habit. A medium-sized tree 15-20 meters (50-66 ft.) high and 30-100 cm. in trunk diameter; slender branches and stout branchlets form a wide-spreading, rounded crown.

Leaves. Alternate, simple, 13-25 cm. long, 8-20 cm. broad; ovate to oblong; often 7-lobed, some with shallow sinuses and broad, rounded, mucronate lobes, others with wide, rounded sinuses extending half-way to the mid-rib or farther, and narrow-oblong or triangular, bristle-tipped lobes, bright crimson as they unfold from the bud, and covered by long, loose, scattered white hairs, and below with thick, pale, silvery-white matted hairs; at maturity thick and leathery; dark green and shining above, pale and more or less hairy beneath; in late autumn turning dull red, orange and brown, and falling gradually during the winter; petioles stout, yellow, 7-15 cm. long.

Flowers. May, when the leaves are developing; monœcious; the staminate in pubescent catkins 10-15 cm. long; the pistillate solitary or in pairs, reddish, on short, tomentose peduncles; calyx acutely 3-4-lobed, reddish, hairy; corolla 0; stamens usually 4-5, with acute, yellow anthers; stigmas 3, divergent, red.

Fruit. Autumn of second year; sessile or short-stalked acorns; cup cup-shaped or top-shaped, inclosing about one-half of the nut; scales of the cup thin, light brown, hoary; nut ovoid, 12-18 mm. long, red-brown, often pubescent; kernel yellow, bitter.

Twigs in Winter. Twigs moderate, fluted. Pith moderate, 5-angled, continuous. Terminal bud 6-12 mm. long, ovoid to conical, obtuse, strongly angled, hoary-hairy; lateral buds clustered towards the tip of the stem, with numerous scales. Leaf scars moderate, half-round, somewhat elevated; bundle scars 10 or more; stipule scars small.

Bark and Wood. Bark of twigs at first scurfy-pubescent, later glabrous, red-brown, finally mottled gray; thick and nearly black on old trunks, deeply furrowed and scaly; inner bark thick, yellow, very bitter, much tannic acid. Wood heavy, hard, strong, coarse-grained, bright red-brown, with thin, paler sapwood; of value only as fuel.

Distribution in the State. The eastern third of the state.

Habitat. Prefers glacial drift; dry or gravelly uplands; poor soils.

Remarks. Very variable, but best recognized by the yellow inner bark and the large tomentose winter buds.

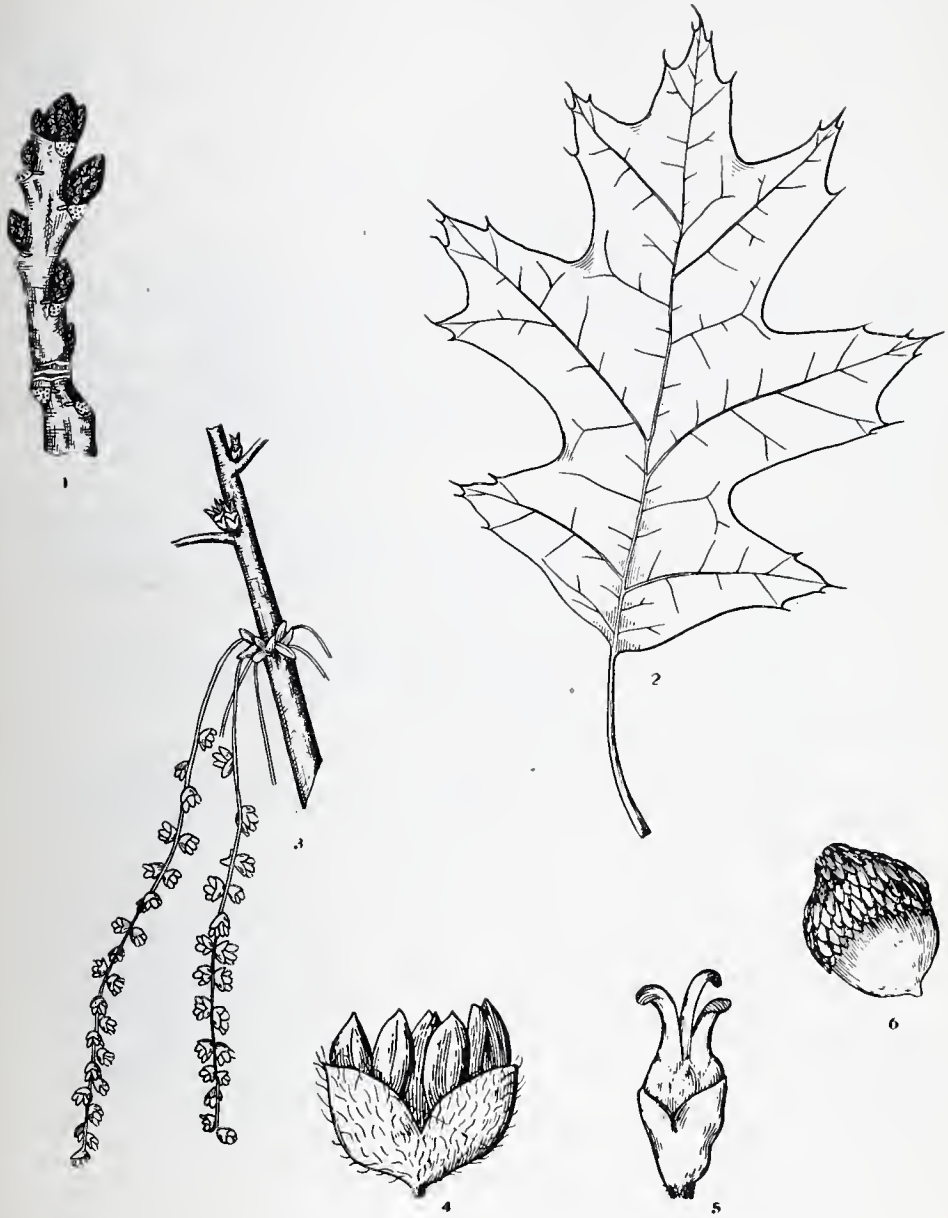

FIG. 199.—*Quercus velutina.*

1. Winter twig, x 1.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

(From Otis: Michigan Trees.)

FAGACEÆ.

Quercus marilandica Muench.

Blackjack Oak.

Habit. A small, shrubby tree 6-9 meters (20-30 ft.) high, with a trunk diameter of 10-30 cm.; usually a shrub; spreading, often contorted branches form a rounded or obovoid crown.

Leaves. Alternate, simple, 13-18 cm. long and broad; broad-obovate; more or less 3-lobed at the apex, the lobes entire or toothed, bristle-tipped, very variable in size and shape; thick and leathery; very shiny and dark green above, yellowish and scurfy-pubescent beneath; petioles short, stout, 12-18 mm. long.

Flowers. May, with the leaves; monœcious; the staminate in slender, hoary catkins 5-10 cm. long; the pistillate rusty-tomentose, on short, rusty-tomentose peduncles; calyx 4-5-lobed, thin, scarious, tinged with red, pale-pubescent; corolla 0; stamens 4, with apiculate tip, red anthers; stigmas recurved, dark red.

Fruit. Autumn of second year; short-stalked acorns; cup turbinate, top-shaped, with large, red-brown, rusty-tomentose scales, inclosing one-half to two-thirds of the nut; nut subglobose, about 18 mm. long, yellow-brown, puberulous; kernel yellowish, not edible.

Twigs in Winter. Twigs moderate, fluted. Pith moderate, 5-angled, continuous. Terminal bud 6 mm. long, ovoid, acute, prominently angled, scales light reddish-brown, rusty-hairy; lateral buds clustered towards the tip of the stem, with numerous scales. Leaf scars moderate, half-round, somewhat elevated; bundle scars 10 or more; stipule scars small.

Bark and Wood. Bark of twigs at first light red and scurfy, later glabrous, red-brown, and finally brown or ashy gray; thick (2-4 cm.) and almost black on the trunk, divided into nearly square plates, 2-8 cm. long, covered with small closely appressed, dark brown or nearly black scales. Wood heavy, hard, strong, dark brown, with thick, lighter colored sapwood; largely used for fuel and in the manufacture of charcoal.

Distribution in the State. Eastern fourth, but west to Riley county in the north.

Habitat. Dry, sandy or clay barrens and rocky bluffs.

Remarks. A variety, *Q. marilandica ashei* Sudworth, is credited to Riley county in Sudworth's "Check List."

FIG. 200.—*Quercus marilandica.*

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

(From Otis: Michigan Trees.)

FAGACEÆ.

Quercus imbricaria Michx.

Shingle Oak, Laurel Oak.

Habit. A tree 12-15 meters (40-50 ft.) high, with a trunk diameter of 30-60 cm.; forming a rather open, rounded crown of slender, horizontal branches.

Leaves. Alternate, simple, 10-15 cm. long, 2.5 to 5 cm. broad; oblong-lanceolate to oblong-obovate, more or less pointed at both apex and base; entire or somewhat undulate; thin or thick, very shining, dark green above, paler and pubescent beneath; turning dark red or brown in the autumn; petioles stout, pubescent, 12 mm. long.

Flowers. May, with the leaves; monœcious; the staminate in slender, hoary-tomentose catkins 5 to 7.5 cm. long; the pistillate singly or in pairs on slender, tomentose peduncles; calyx 4-lobed, yellow, downy; corolla 0; stamens 4-5, with yellow anthers; stigmas short, recurved, greenish yellow.

Fruit. Autumn of second year; acorns on stout peduncles 12 mm. long; cup cup-shaped, with red-brown, downy scales, inclosing one-third to one-half of the nut; nut subglobose, about 12 mm. long, dark brown, often striate; kernel very bitter.

Twigs in Winter. Twigs moderate, fluted. Pith moderate, 5-angled, continuous. Terminal bud about 3 mm. long, ovoid, acute, shining, obscurely angled, covered by closely overlapping, light chestnut-brown scales, often fringed with fine hairs; lateral buds clustered towards the tip. Leaf scars moderate, half-round, somewhat elevated; bundle scars 10 or more, scattered; stipule scars small.

Bark and Wood. Bark of twigs shining, dark green, becoming brown; thick on old trunks, light brown and slightly fissured, the ridges covered with close-fitting brownish scales. Wood heavy, hard, coarse-grained, light red-brown, with thin, lighter colored sapwood; occasionally used in construction, shingles, furniture, etc.

Distribution in the State. Kansas River valley in extreme eastern part of the state.

Habitat. Rich uplands in ravines; fertile river bottoms.

Remarks. Desirable as an ornamental tree.

FIG. 201.—*Quercus imbricaria.*

1. Winter twig, x 2.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

(From Otis: Michigan Trees.)

FAGACEÆ.

Quercus alba L.

White Oak.

Habit. A large tree 15-25 meters (50-83 ft.) high, with a trunk diameter of 30-100 cm., forming a short, thick trunk with stout, horizontal, far-reaching limbs, more or less gnarled and twisted in old age, and a broad, open crown.

Leaves. Alternate, simple, 13-23 cm. long, 8-10 cm. wide; obovate to oblong; 5-9 lobed (commonly 7), some with broad lobes and shallow sinuses, others with narrow lobes and deep, narrow sinuses, the lobes usually entire; thin and firm; glabrous, bright green above, pale or glaucous beneath; often persistent on the tree through the winter. Petioles short, stout, grooved, flattened.

Flowers. May, with the leaves; monœcious; the staminate in hairy catkins 5 to 7.5 cm. long; calyx bright yellow, hairy, 6-8-lobed, stamens 6-8, with yellow anthers; the pistillate sessile or short-peduncled, reddish, hairy; calyx campanulate, 6-8-lobed, hairy; corolla 0; stigmas red.

Fruit. Autumn of first season; sessile or short-stalked acorns; cup with small, brown-hairy scales, inclosing one-fourth of the nut; nut oblong-ovoid, rounded at the apex, about 18 mm. long, light brown; kernel sweet and edible.

Twigs in Winter. Twigs moderate, fluted. Pith moderate, five-angled, continuous. Terminal bud about 3 mm. long, broadly-ovoid, obtuse, scales smooth, dark reddish-brown; lateral buds clustered towards the tip, with numerous scales. Leaf scars moderate, half-round, somewhat elevated; bundle scars 10 or more, scattered or partly in an ellipse; stipule scars small.

Bark and Wood. Bark of twigs at first bright green, tomentose, later reddish, and finally ashy gray; thick, light gray or whitish on old trunks, shallowly fissured into broad, flat ridges. Wood very heavy, strong, hard, tough, close-grained, durable, valuable, light brown, with thin, light brown sapwood.

Distribution in the State. Found sparingly in eastern Kansas, from Wyandotte county northward.

Habitat. Grows well in all but very wet soils, in all open exposures.

Remarks. The small size of the trees might suggest that the tree is relatively a newcomer to the state.

FIG. 202.—*Quercus alba.*

1. Winter twig, x 2.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

(From Otis: Michigan Trees.)

FAGACEÆ.

Quercus stellata Wang.

Post or Iron Oak.

Habit. A medium-sized tree under 18 meters (60 ft.) in height, stout, spreading branches forming a dense round topped head, or dwarfed to shrub form.

Leaves. Alternate, simple, 12-20 cm. long and 10-15 cm. wide or less; 3-7 broad rounded deeply-undulate or toothed deep lobes; when mature firm, glabrous, dark green and shining above, brown tomentulose beneath; petioles stout, 12-25 mm. long.

Flowers. May, with the leaves; the staminate in catkins 8-10 cm. long, calyx hirsute, yellow, usually divided into 5 more or less cut lobes, anthers with scattered hairs; pistillate sessile or short stalked, their scales broadly ovate, hirsute, stigmas bright red.

Fruit. Autumn of the first year; acorns sessile or short stalked, oval to somewhat oblong, broad at the base, obtuse and sometimes hairy at tip, 12-25 mm. by 6-18 mm., inclosed for one-third to one-half its length in the cup or top-shaped cup, which is pubescent on the inner surface, hoary-tomentose on the outer, the thin ovate scales rounded and acute at the apex, reddish brown and especially the inner ciliate on the margins, with long pale hairs.

Twigs in Winter. Twigs moderate or stout. Pith moderate, 5-angled, continuous. Terminal bud 3-6 mm. long, broadly ovate, obtuse or rarely acute, with bright chestnut-brown pubescent scales coated towards the margins with long pale hairs; lateral buds clustered towards the tip of the stem. Leaf scars moderate, half-round, somewhat elevated; bundle scars 10 or more; stipule scars small.

Bark and Wood. Bark of twigs light orange to reddish-brown, pubescent, ultimately gray, dark brown or nearly black, or nearly black or bright brown cast with orange, becoming 12-25 mm. thick, red, more or less deeply tinged with brown, and divided by deep fissures into broad ridges covered with narrow, closely appressed scales. Wood hard, very heavy, close-grained, durable in contact with the soil, light or dark brown, with thick lighter colored sapwood; used largely for fuel, fencing, and railroad ties, but sometimes used for construction.

Distribution in the State. Principally in the southern half of the eastern third of the state.

Habitat. Dry gravelly uplands.

Remarks. Trees resembling white oak.

FIG. 203.—*Quercus stellata.*

1. Winter twig, x ¾.
2. Portion of winter twig, enlarged.
3. Twig showing several staminate inflorescences and three pistilate flowers, reduced.
4. Fruiting twig, x ½.
5. Fruit, x ½.

(Original.)

FAGACEÆ.

Quercus macrocarpa Michx.

Bur Oak.

Habit. A large tree, 12-25 or 30 meters (40-80 or 100 ft.) high and 0.5 to 1.5 meters in diameter, usually with short trunks and broad, massive tops, with very rugged and angular horizontal branches, in the dry upland soil westward dwarfed to a shrub.

Leaves. Alternate, simple, 15-25 cm. long and one-half as broad; obovate to oblong, wedge-shaped at the base; crenately 5-7-lobed, the terminal lobe largest, usually cut nearly to the midrib by two opposite sinuses near the middle; thick and firm; dark green and shining above, pale pubescent beneath; petioles short, stout.

Flowers. May, with the leaves; monœcious; the staminate in slender, hairy catkins 10-15 cm. long from last year's twigs; the pistillate inconspicuous, sessile or short-stalked in groups of 1-4 upon the young shoots, reddish, tomentose; calyx 4-6-lobed; yellow-green, downy; corolla 0; stamens 4-6, with yellow anthers; stigmas bright red.

Fruit. Autumn of first season; sessile or short-stalked acorns; very variable in size and shape; cup typically deep, cup-shaped, tomentose, fringed at the rim inclosing one-third or all of the nut; nut broad-ovoid, 1-4 cm. long, brownish, pubescent; kernel white, sometimes sweet and edible.

Twigs in Winter. Twigs moderate, fluted. Pith moderate, 5-angled, continuous. Terminal bud about 3 mm. long, broadly ovoid or conical, reddish brown, pale pubescent; lateral buds clustered towards the tip, with numerous scales. Leaf scars moderate, half-round, somewhat elevated; bundle scars 10 or more, scattered; stipule scars small.

Bark and Wood. Bark of twigs yellow-brown, thick-tomentose, becoming ash-gray or brownish; branches with corky ridges; thick and gray-brown on the trunk, deeply furrowed, sometimes scaly. Wood heavy, hard, strong, tough, close-grained, very durable, brownish, with thin, pale sapwood.

Distribution in the State. At least the eastern half; the most widely distributed oak in the state.

Habitat. Prefers a rich, moist soil; bottom lands; but is tolerant of many soils.

Remarks. A valuable ornamental and lumber tree.

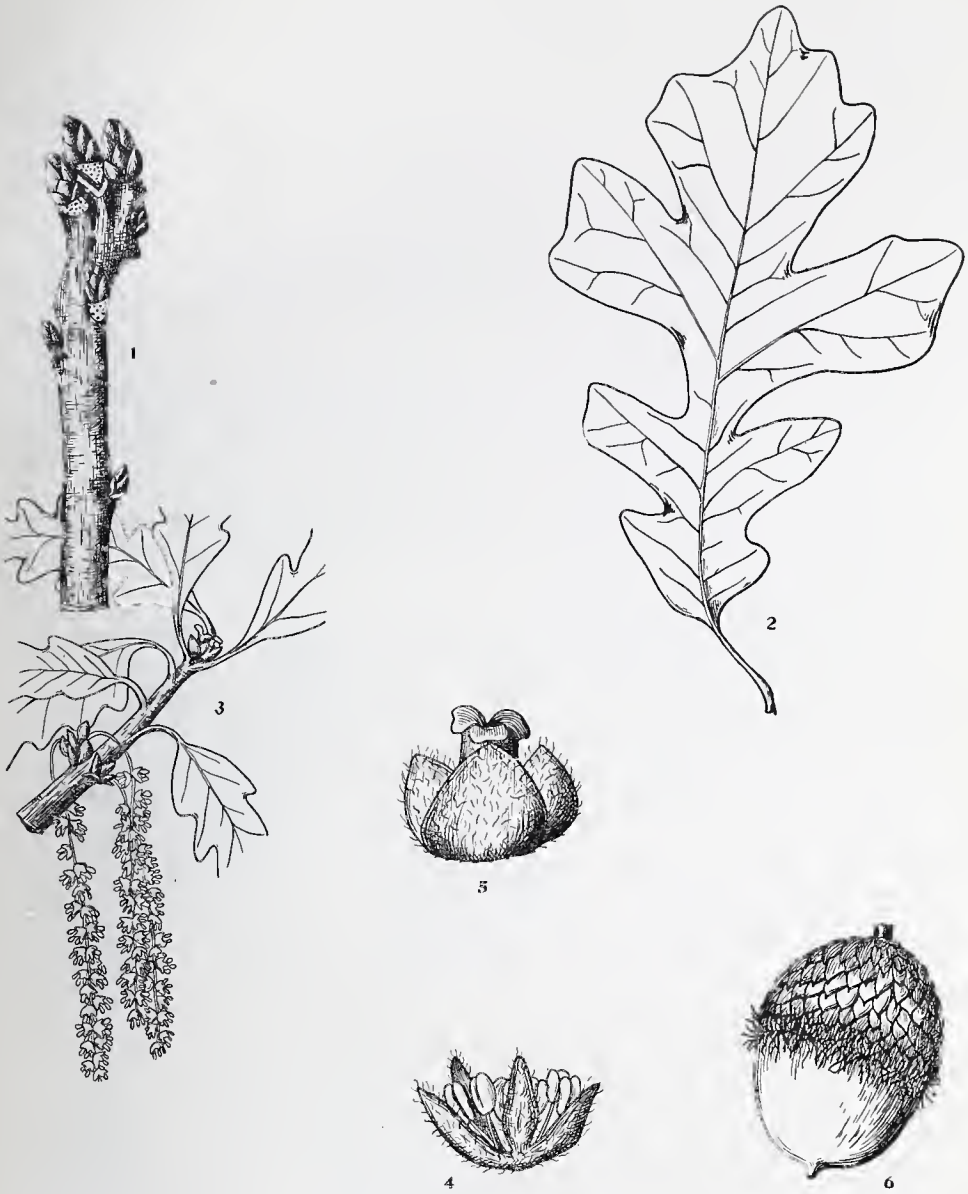

FIG. 204.—*Quercus macrocarpa.*

1. Winter twig, x 2.
2. Leaf, x ⅓.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

(From Otis: Michigan Trees.)

FAGACEÆ.

Quercus muehlenbergii Engelm.

Chinquapin Oak, Chestnut Oak, Yellow Oak.

Habit. A medium-sized tree 10-15 meters (33-50 ft.) high, with a trunk diameter of 30-100 cm.; erect, somewhat short branches form a narrow, rounded crown, westward dwarfed to a shrub.

Leaves. Alternate, simple, 10-18 cm. long, 2.5 to 10 cm. broad; oblong-lanceolate to obovate; coarsely toothed, the teeth tipped with a small glandular point; thick and firm; shining, yellow-green above, pale-pubescent beneath, turning deep yellow and scarlet in the autumn; petioles slender, about 2.5 cm. long.

Flowers. May, with the leaves; monœcious; the staminate in hairy catkins 7-10 cm. long; the pistillate sessile or in short spikes, hoary-tomentose; calyx bell-shaped, 5-8-lobed, yellow, hairy; corolla 0; stamens 5-8, with yellow anthers; stigmas red.

Fruit. Autumn of first season; sessile or short-stalked acorns; cup with small scales, hoary-tomentose, inclosing one-half of the nut; nut ovoid, about 18 mm. long, light brown; kernel sweet, sometimes edible.

Twigs in Winter. Twigs moderate, fluted. Pith moderate, 5-angled, continuous. Terminal bud 3 mm. long, conical, acute, scales chestnut-brown, more or less hairy and also fringed; lateral buds clustered towards the tip of the stem, with numerous scales. Leaf scars moderate, half-round, somewhat elevated; bundle scars 10 or more, scattered; stipule scars small.

Bark and Wood. Bark of twigs greenish at first, becoming orange or gray-brown, finally gray or brown. Thin, silvery gray or ash-colored and flaky on the trunk, usually less than 12 mm. thick. Wood heavy, very hard, strong, close-grained, durable, dark brown, with thin, pale brown sapwood; used principally for fuel, fence posts, cooperage, railway ties, etc.

Distribution in the State. Eastern third of the state.

Habitat. Prefers a limestone soil; dry hillsides; rich bottom lands; rocky river banks. Usually growing on higher ground than the bur oak.

Remarks. Frequently forming the bulk of the trees in forested areas.

Quercus prinoides Willd. The Scrub or Dwarf Chestnut Oak or Dwarf Chinquapin Oak is a shrub, or seldom a small tree, in the eastern third of Kansas, which differs from *Quercus muehlenbergii* in being a shrub with wider leaves (5 to 7.5 cm.), the teeth of the leaves short, triangular and in having the acorns 2-3 times as high as the cup instead of about twice as high.

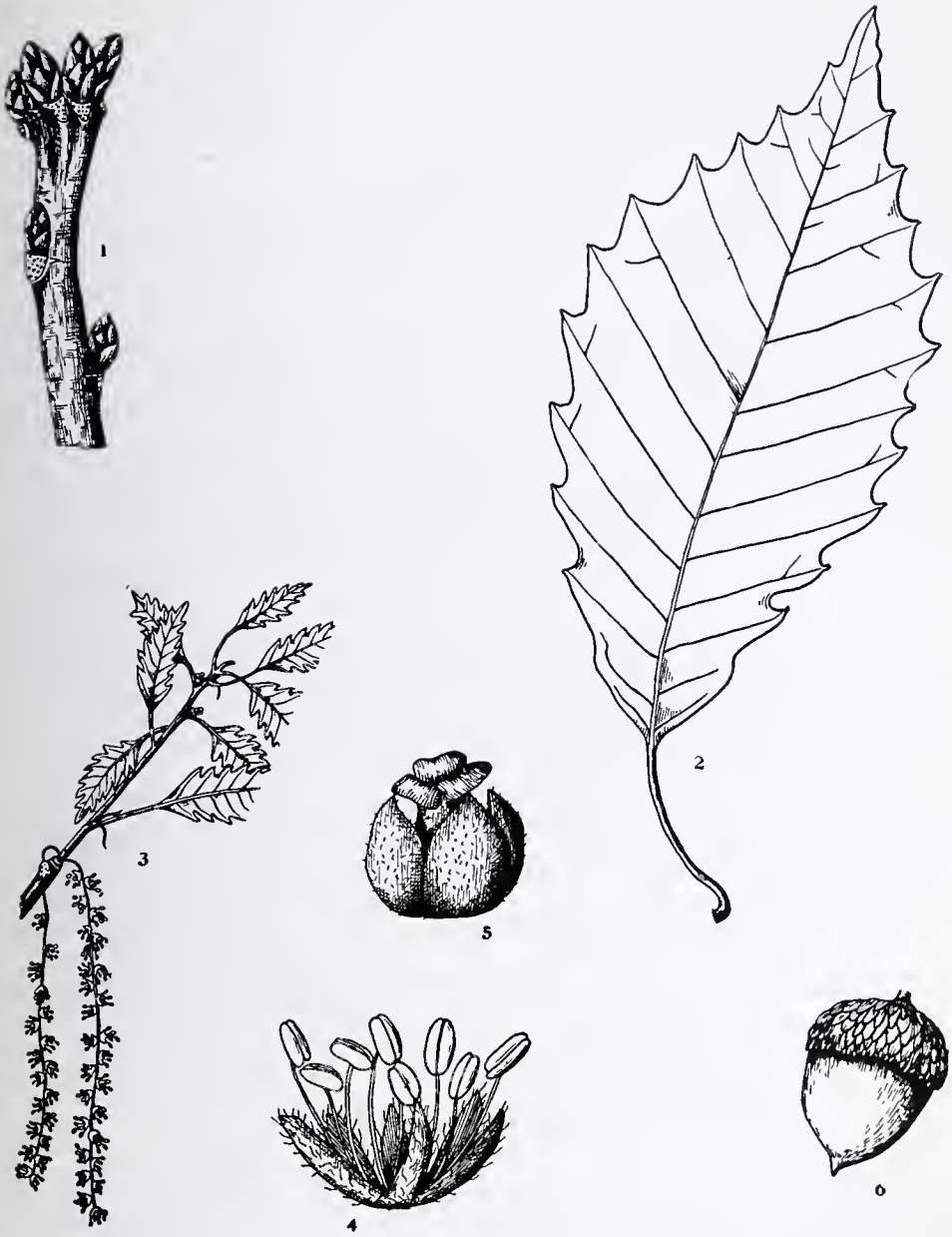

FIG. 205.—*Quercus muehlenbergii.*

1. Winter twig, x 2.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

(From Otis: Michigan Trees.)

CORNACEÆ.

Cornus florida L.

Flowering Dogwood.

Habit. A bushy tree with a height of 4-9 meters (13-30 ft.) and a short trunk 10-20 cm. in diameter or less; slender, spreading branches form a flat-topped crown.

Leaves. Opposite, closely clustered at the ends of the branchlets, simple, 8-13 cm. long, 5 to 7.5 cm. broad; ovate to elliptical; obscurely wavy-toothed; thick and firm; bright green, covered with minute, appressed hairs above, pale and more or less pubescent beneath, turning bright scarlet in autumn; petioles short, grooved.

Flowers. May, with the leaves; perfect; greenish; in dense clusters surrounded by 4 large, white or pinkish, petal-like bracts (often mistaken for the corolla), borne on short, stout peduncles; calyx 4-lobed, light green; petals 4, yellow-green; stamens 4, alternate with the petals; ovary 2-celled.

Fruit. October; an ovoid, scarlet drupe, borne in close clusters of 3-4; flesh is bitter.

Twigs in Winter. Twigs moderate, greenish. Pith moderate. Leaf buds narrow-conical, acute, greenish; flower buds spherical or vertically flattened, grayish. Leaf scars crescent-shaped, raised during the first winter on petiole bases that are later deciduous at the level of the twig; bundle scars 3; stipule scars lacking, but the leaf scars meet or are transversely joined.

Bark and Wood. Bark of twigs pale green, becoming red or yellow-green their first winter, later becoming light brown or red-gray; red-brown or blackish on the trunk, often separating into quadrangular, plate-like scales. Wood heavy, hard, strong, rough, close-grained, brownish, with thick, lighter colored sapwood.

Distribution in the State. Only in the Spring River valley, Cherokee, county.

Habitat. Prefers rich, well-drained soil, usually under the shade of other trees.

Remarks. A very desirable ornamental where it can be grown. Other species of *Cornus* are shrubs, some very common.

RUBIACEÆ.

Cephalanthus occidentalis L., the Buttonbush, is but a shrub in Kansas, although farther southward becomes a tree. It is found only along watercourses, and is recognized by the lanceolate leaves normally in whorls of three (sometimes opposite) on slender twigs with buds depressed in a pit above the axil. The flowers are closely bunched in a globular head and at least some of the fruit is persistent through the winter.

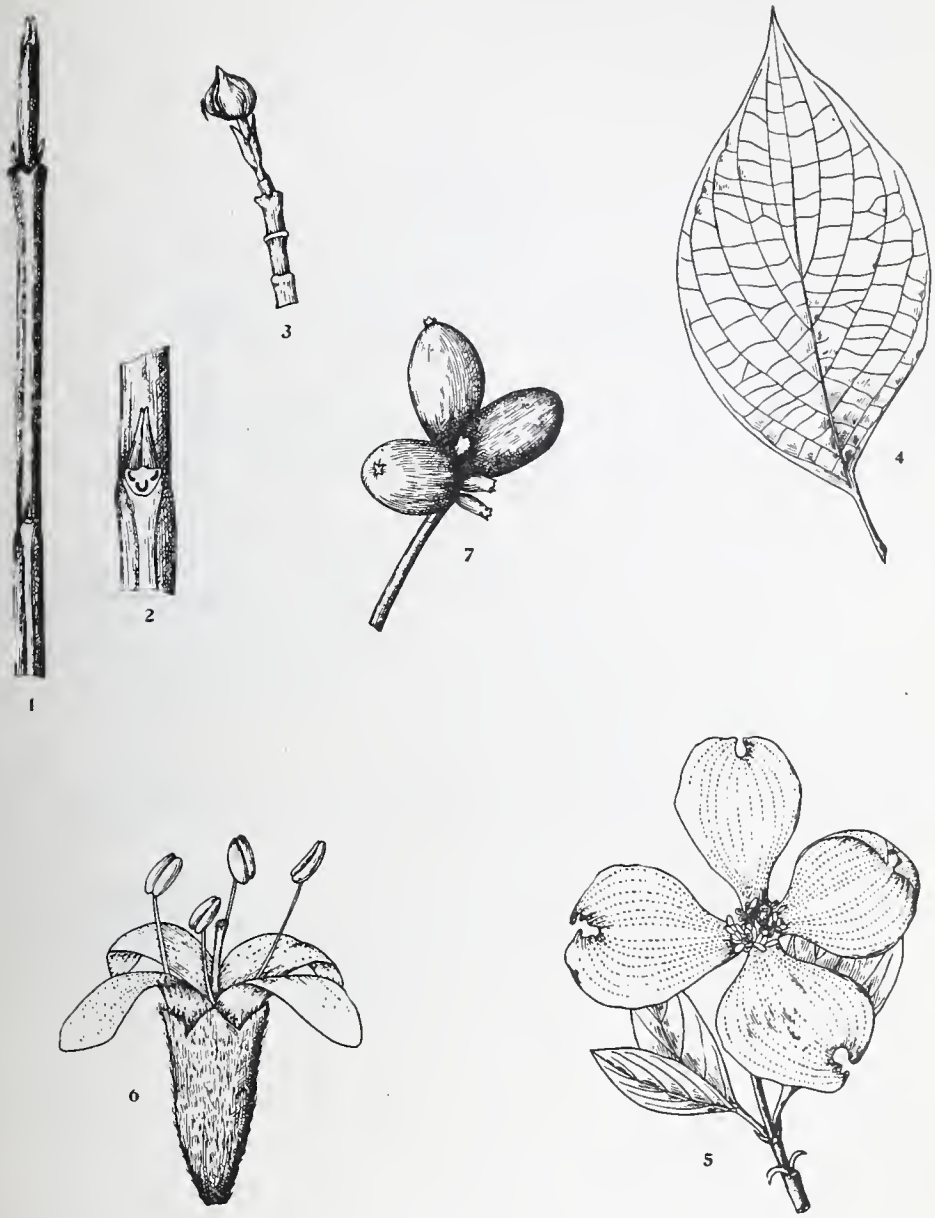

FIG. 206.—*Cornus florida.*

1. Winter twig, with leaf buds, x 1.
2. Portion of twig, enlarged.
3. Winter twig, with flower bud, x 1.
4. Leaf, x ½.
5. Flowering branchlet, x ½.
6. Flower, enlarged.
7. Fruit, x 1.

(From Otis: Michigan Trees.)

CAPRIFOLIACEÆ.

Viburnum lentago L.

Sheepberry, Nannyberry, Black Haw.

Habit. A low tree or shrub 4-8 meters (13-26 ft.) high, with a short trunk 7-20 cm. in diameter; numerous tortuous branches form a wide, compact, rounded crown.

Leaves. Opposite, simple, 5-10 cm. long, one-half as broad; ovate to sub-orbicular; finely and sharply serrate; thick and firm; shiny, bright green above, pale and marked with tiny black dots beneath; petioles broad, grooved, more or less winged, about 2.5 cm. long.

Flowers. May-June, after the leaves; perfect; small; cream-white, borne in stout branches, scurfy, flat, terminal clusters 8-13 cm. across; calyx tubular, 5-toothed; corolla 5-lobed, cream color or white, 6 mm. across; stamens 5, with yellow anthers; ovary 1-celled, with short, thick, green style, and broad stigma.

Fruit. September; a fleshy drupe, 12 mm. long, ovoid, flattened, blue-black, borne in few-fruited, red-stemmed clusters; stone oval, flat, rough; flesh sweet, edible.

Twigs in Winter. Twigs rather slender, more or less 6-sided. Pith moderate, more or less 6-sided, whitish, continuous. Leaf-buds narrow, acute, red, scurfy-pubescent, 12 mm. long with a pair of scales; flower-buds swollen at the base, with spire-like apex, grayish with scurfy pubescence, 18 mm. long. leaf scars crescent-shaped; bundle scars 3; stipule scars lacking.

Bark and Wood. Bark of twigs at first light green, rusty-pubescent, becoming dark red-brown; red-brown on old trunks and broken into small, thick plates, becoming more or less scaly. Wood heavy, hard, close-grained, ill-smelling, dark orange-brown, with thin, whitish sapwood.

Distribution in the State. Extreme eastern part of the state, most abundant in the southeastern part.

Habitat. Prefers a rich, moist soil along the borders of forests; roadsides; river banks.

Remarks. Very attractive to birds, quite ornamental; seeds germinate in the second year after planting.

FIG. 207.—*Viburnum lentago.*

1. Winter twig, with leaf buds, x 1.
2. Winter twig, with flower bud, x 1.
3. Leaf, x ¾.
4. Flower, enlarged.
5. Fruiting branchlet, x ½.

(From Otis: Michigan Trees.)

CAPRIFOLIACEÆ.

Viburnum prunifolium L.

Black Haw.

Habit. A small tree, sometimes 15 cm. in diameter and 3-5 meters (10-16 ft.) high, with crooked trunk and stout spreading branches, beset with slender, spinelike twigs.

Leaves. Opposite, simple, 2.5 to 7.5 cm. long, ovate or rarely obovate or oval, rounded, acute, or short-pointed at the apex, wedge shaped or rounded at the base, and usually rather remotely or sometimes finely serrate, with rigid incurved callous-tipped teeth, glabrous or nearly so; petioles terete, grooved, 12-16 mm. long, on vigorous shoots sometimes narrowly wing-margined.

Flowers. April-May, with or a little before the leaves; 6 mm. in diameter, on slender pedicles, 2-bracted at the apex, in glabrous cymes 5-10 cm. in diameter; calyx narrowly obovate, with short rounded lobes often tipped with pink; corolla pure white, with oval or nearly orbicular lobes.

Fruit. October, few-fruited red-stemmed clusters, persistent on the branches until the beginning of winter, oval or slightly obovate, 12-16 mm. long, dark blue, and covered with a glaucous bloom; stone about 12 by 8 mm., very flat on one side, slightly convex on the other; edible.

Twigs in Winter. Twigs slender, gray, tinged with red, covered with a slight bloom, lenticels orange. Pith moderate, whitish, continuous. Buds short-pointed or obtuse, rufous pubescent, those containing flower-bearing branches about 12 mm. long and 6 mm. wide and about twice as large as those containing sterile twigs; lateral buds acute, flattened, much smaller than the terminal buds. Leaf scars crescent-shaped; bundle scars 3; stipule scars lacking.

Bark and Wood. Bark of twigs bright red and glabrous, soon green, then gray, with red tinge and slight bloom, ultimately dark brown tinged with red; on the trunk, broken into thick, irregular, platelike, reddish-brown scales. Wood heavy, hard, strong, brittle, close-grained, brown tinged with red, with thick, nearly white sapwood.

Distribution in the State. Southeastern part of the state, westward to Winfield and northward to Johnson county.

Habitat. Dry soil.

Remarks. Very attractive, especially to birds.

FIG. 208.—*Viburnum prunifolium.*

1. Winter twig, x ¾.
2. Portion of winter twig, showing flower bud.
3. Inflorescence, reduced.
4. Side view of flower, x ½.
5. Upper view of flower, x ½.
6. Section of flower, enlarged.
7. Fruiting branch.
8. Detail of margin of leaf.

(Original.)

CAPRIFOLIACEÆ.

Viburnum rufidulum Raf.

Rusty Black Haw.

Habit. A small tree, sometimes about 25 cm. in diameter and about 6 meters (20 ft.) high, the short, thick branches forming an open, irregular head.

Leaves. Opposite, simple, usually about 7.5 cm. long and 2-4 cm. wide, elliptical to obovate, mostly obtuse at the apex, finely and sharply serrate or serrulate, narrowed or obtuse at the base, the veins brown tomentose beneath; petioles stout, grooved, 6-18 mm. long, winged, brown tomentose.

Flowers. April-May, with or a little before the leaves; 6 mm. in diameter, in compound sessile or stalked clusters, often 5-6 inches in diameter, with minute subulate bracts and bractlets; calyx obconic with short rounded lobes; corolla creamy white, with orbicular or oblong rounded lobes.

Fruit. October, in few-fruited, drooping, red-stemmed clusters, oval, bright blue covered with a glaucous bloom, 10-16 mm. long; stone about 11 mm. long and about 8 mm. wide.

Twigs in Winter. Twigs slender, ashy gray to dull reddish-brown, with numerous small reddish-brown or orange lenticels. Pith moderate, whitish, continuous. Buds brown tomentose, those containing flower-bearing twigs broadly ovate, full and rounded at the base, abruptly narrowed above, and short-pointed and obtuse at the apex, compressed, often 12 mm. long and 8 mm. wide, and rather larger than those containing sterile twigs; lateral buds acute, flattened by pressure against the stems and much smaller than the terminal buds. Leaf scars crescent-shaped; bundle scars 3; stipule scars lacking.

Bark and Wood. Bark of twigs gray to reddish-brown, brown tomentose becoming glabrous; on the trunk separating into narrow-rounded ridges divided by numerous cross fissures, and roughened by small, platelike, dark brown scales tinged with red. Wood ill-smelling.

Distribution in the State. Southeastern part.

Habitat. Dry upland woods and margins of river bottom lands.

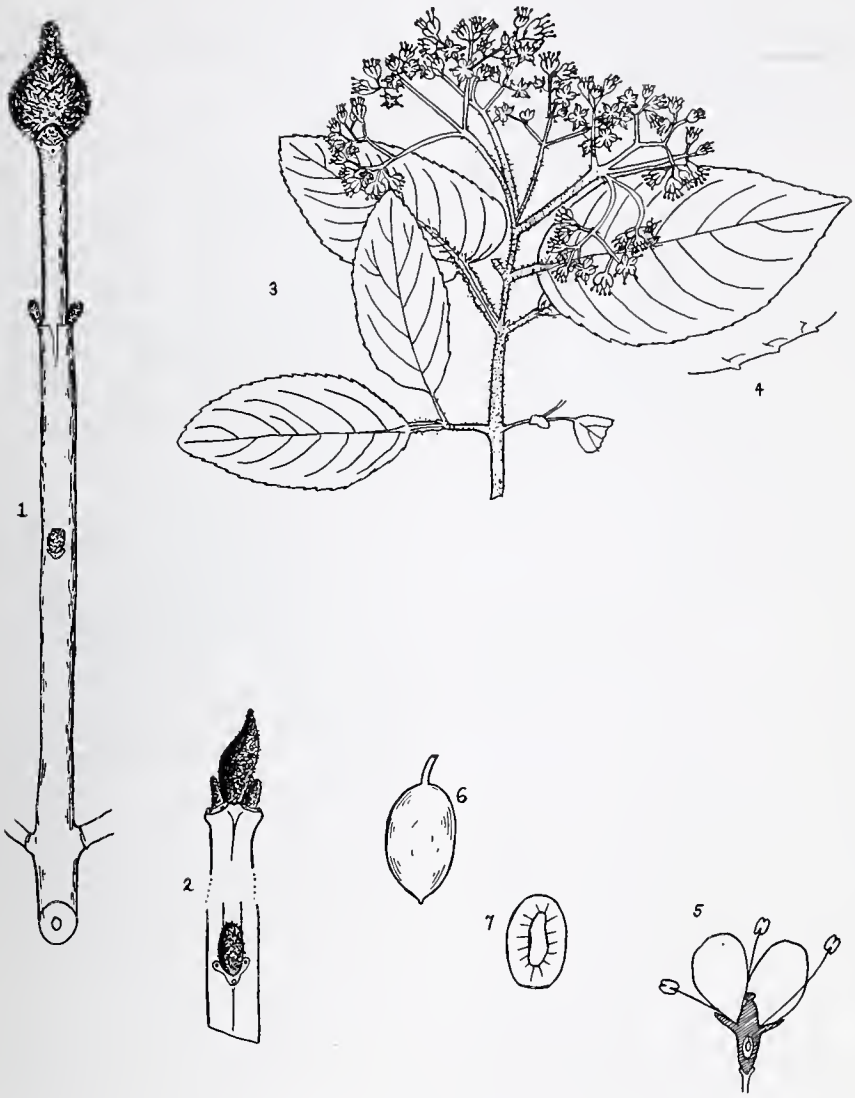

FIG. 209.—*Viburnum rufidulum.*

1. Top view of winter twig, x 1.
2. Side view of winter twig, x 1.
3. Leafy twig, showing inflorescence, x ⅓.
4. Detail of leaf margin, enlarged.
5. Section of flower, enlarged.
6. Fruit, x 1.
7. Section of fruit, showing stone, x 1.

(Original.)

GLOSSARY.

Abortion. Imperfect development or nondevelopment of an organ or part.
Acuminate. Gradually tapering to the apex.
Acute. Terminating with a sharp angle.
Akene. A 1-seeded, dry, indehiscent fruit.
Alternate. Said of leaves, branches, buds, etc., scattered singly along the stem; not opposite.
Ament. Same as catkin, which see.
Anther. The part of a stamen which bears the pollen.
Apetalous. Without petals.
Apex. The top, as the tip of a bud or the end of a leaf which is opposite the petiole.
Apiculate. Ending in a short-pointed tip.
Appressed. Lying close and flat against.
Arborescent. Treelike in size or appearance.
Aromatic. Fragrant; with an agreeable odor.
Axil. The upper one of the two angles formed by the juncture of a leaf with a stem.
Axillary. Situated in an axil.
Axis. The central line of an organ; a stem.

Bark. The outer covering of a trunk or branch.
Bearded. Bearing a long, bristlelike appendage, or furnished with long or stiff hairs.
Berry. A fruit which is fleshy throughout.
Bipinnate. Twice pinnate.
Blade. The expanded portion of a leaf.
Bloom. A powdery or waxy substance easily rubbed off.
Bract. A more or less modified leaf subtending a flower or belonging to an inflorescence.
Branch. A secondary division of a trunk.
Branchlet. A small branch; a twig.
Bud. An undeveloped stem or branch, with or without scales.
Bud scales. Modified leaves covering a bud.
Bundle scars. Dots on the surface of a leaf scar, which are scars left by the fibrovascular bundles which run through the petiole into the blade of the leaf.
Bur. A spiny fruit.

Calyx. The outer part of a perianth, usually green in color.
Campanulate. Bell-shaped.
Capsule. A dry fruit of more than one carpel which splits at maturity to release the seeds.
Carpel. A simple pistil, or one member of a compound pistil.
Catkin. A spike of unisexual flowers, each subtended by a bract, and usually deciduous in one piece.
Chambered. Said of pith which is interrupted by hollow spaces at fairly regular intervals.
Ciliate. Fringed with hairs on the margin.
Cinereous. Ash-gray color.
Claw. The narrow, stalklike base of a petal, sepal, etc.
Cleft. Cut about half way to the middle.
Cluster. A group of two or more organs (flowers, fruit, etc.) on a plant at a node or end of a stem.
Compound. Composed of two or more similar parts united into a whole.
Compound leaf. One divided into separate leaflets.
Cone. A fruit with woody, overlapping scales.
Conical. Cone-shaped, largest at the base and tapering to the apex.
Cordate. Heart-shaped.
Coriaceous. Leatherlike in texture.
Corolla. The inner part of a perianth, composed of petals, usually bright colored.
Corymb. A flower cluster in which the axis is shortened and the pedicels of the lower flowers lengthened, forming a flat-topped inflorescence, the marginal flowers blooming first.
Corymbose. Arranged in corymbs.
Crenate. Dentate, with teeth much rounded.
Crenulate. Finely crenate.
Crown. The upper part of a tree, including the living branches with their foliage.
Cutting. A piece of the stem, root or leaf which, if cut off and placed in contact with the soil, will form new roots and buds, reproducing the parent plant.
Cyme. A broad and flattish inflorescence, the central flowers of which bloom first.
Cymose. Arranged in cymes.

Deciduous. Not persistent; falling away, as the leaves of a tree in autumn.
Decurrent. Said of a leaf which extends down the stem below the point of fastening.
Decussate. Alternating in pairs at right angles.
Dehiscent. Opening by valves or slits.
Deltoid. Delta-shaped.
Dentate. Toothed, with the teeth usually pointed and directed outward.
Depressed. Somewhat flattened from above.

Dichotomous. Branching regularly in pairs.
Digitate. Said of a compound leaf in which the leaflets are borne at the apex of the petiole; finger-shaped; palmate.
Diœcious. Unisexual, with staminate and pistillate flowers on different individuals.
Divergent. Said of buds, cones, etc., which point away from the twig, or of pine needles, etc., which spread apart.
Downy. Covered with fine hairs.
Drupe. A fleshy or pulpy fruit in which the inner portion is hard or stony.

Ellipsoid. An elliptical solid.
Elliptical. Oval or oblong with regularly rounded ends.
Emarginate. Notched at the apex.
Entire. Without divisions, lobes or teeth.
Excrescences. Warty outgrowths or protuberances.
Exfoliate. To cleave off, as of the outer layers of bark.

Falcate. Scythe-shaped.
Fascicle. A compact cluster of leaves or flowers.
Fascicled. Arranged in fascicles.
Fastigiate. Said of branches which are erect and near together.
Fertile. Capable of bearing fruit.
Fertilization. The process in which the units (male) produced in the pollen tube, which grows from the pollen grain, unite with the female units produced within the ovule and induce the development of an embryo in the seed.
Filament. The stalk part of a stamen which bears the anther.
Filamentose or *Filamentous.* Composed of threads or filaments.
Flaky. With loose scales easily rubbed off (bark).
Fleshy. Succulent; juicy.
Flower. An axis bearing stamens or pistils or both (calyx and corolla usually accompany these).
Fluted. With rounded ridges.
Fruit. The part of a plant which bears the seed. The ripened ovary often with other flower parts.

Genus. A group of related species.
Germinate. To sprout, as of a seed.
Glabrous. Neither rough, pubescent, nor hairy; smooth.
Gland. Secreting surface or structure; a protuberance having the appearance of such an organ.
Glandular. Bearing glands.
Glaucous. Covered or whitened with a bloom.
Globose. Spherical or nearly so.

Habit. The general appearance of a plant, best seen from a distance.
Habitat. The place where a plant naturally grows, as in water, clay soil, marsh, etc.
Hairy. With long hairs.
Head. A dense cluster of sessile flowers.
Heartwood. The dead central portion of the trunk or large branch of a tree.
Hirsute. Covered with rather coarse or stiff hairs.
Hoary. Gray-white with a fine, close pubescence.

Imbricate. Overlapping, like the shingles on a roof.
Incomplete. Flowers in which one or more whorls are missing.
Indehiscent. Not opening by valves or slits; remaining persistently closed.
Inflorescence. The flowering part of a plant, and especially its arrangement.
Internode. The portion of a stem between two nodes.
Involucre. A circle of bracts surrounding a flower or cluster of flowers.
Irregular. Said of flower showing inequality of form or size of similar parts.

Keeled. With a central ridge like the keel of a boat.

Lanceolate. Lance-shaped, broadest above the base and tapering to the apex, but several times longer than wide.
Lateral. Situated on the side of a branch.
Leaf. The green expansions borne by the branches of a tree consisting of a blade with or without a petiole and with or without stipules.
Leaflet. One of the small blades of a compound leaf.
Leaf scar. The scar left on a twig by the falling of a leaf.
Legume. A podlike fruit composed of a solitary carpel and usually splitting open by both sutures.
Lenticels. Corky growths on young bark which admit air to the interior of a twig or branch.
Linear. Long and narrow, with parallel edges (as pine needles).
Lobe. Any division of an organ, especially if rounded.
Lobed. Provided with a lobe or lobes.

Membranaceous. Thin and somewhat translucent.
Midrib. The central vein of a leaf or leaflet.
Monœcious. Unisexual, with staminate and pistillate flowers on the same individual.
Mucilaginous. Slimy; resembling or secreting mucilage or gum.

Mucronate. Tipped with a small, abrupt point.

Naked. Lacking organs or parts which are normally present in related species or genera.
Naturalized. Said of introduced plants which are reproducing by self-sown seeds.
Nectariferous. Producing nectar.
Nerve. One of the lines or veins in a leaf.
Node. The place upon a stem which normally bears a leaf or whorl of leaves.
Nut. A hard and indehiscent, 1-celled, 1-seeded fruit.
Nutlet. A diminutive nut.

Oblanceolate. Lanceolate, with the broadest part toward the apex.
Oblique. Slanting, or with unequal sides.
Oblong. Longer than broad, with sides approximately parallel.
Obovate. Ovate, with the broadest part toward the apex.
Obovoid. An ovate solid with the broadest part toward the apex.
Obtuse. Blunt or rounded at the apex.
Opaque. Dull; neither shining nor translucent.
Opposite. Said of leaves, branches, buds, etc., on opposite sides of a stem at a node.
Orbicular. Circular.
Oval. Broadly elliptical.
Ovary. The part of a pistil that contains the ovules.
Ovate. Egg-shaped, with the broad end basal.
Ovoid. Solid ovate or solid oval.
Ovule. The part of a flower which after fertilization becomes the seed.

Palmate. Radiately lobed or divided; hand-shaped.
Panicle. A loose, irregularly compound inflorescence with pedicellate flowers.
Papilionaceous. Butterflylike, as in flowers of the pea or bean family.
Pedicel. The stalk of a single flower in a compound inflorescence.
Pedicellate. Borne on a pedicel.
Peduncle. A primary flower stalk, supporting either a cluster or a solitary flower.
Peltate. Fixed to the stalk by the center.
Pendent. Hanging downward.
Perfect. Said of a flower with both stamens and pistil.
Perianth. The calyx and corolla of a flower considered as a whole.
Persistent. Long continuous, as leaves through the winter, calyx on the fruit, etc.
Petal. One of the divisions of a corolla.
Petiolate. Having a petiole.
Petiole. The stem or stalk of a leaf.
Petiolulate. Having a petiolule.
Petiolule. The stem or stalk of a leaflet.
Pilose. Hairy with long, soft hairs.
Pinnate. Compound, with the leaflets arranged along both sides of a common petiole.
Pistil. The seed-bearing organ of a flower, normally consisting of ovary, style and stigma.
Pistillate. Provided with a pistil, but usually without stamens.
Pith. The softer central part of a twig or stem.
Pollen. The microspores (dustlike substance in the anthers of the flower) which on a suitable stigma may grow into the pollen tube (male gametophyte) and produce the male gametes (male sex units).
Pollination. The process of bringing the pollen from the anther to the stigma.
Polygamo-diœcious. Sometimes perfect, sometimes unisexual, both forms borne on different individuals.
Polygamo-monœcious. Sometimes perfect, sometimes unisexual, both forms borne on the same individual.
Polygamous. Sometimes perfect, sometimes unisexual, both forms borne on the same or on different individuals.
Pome. A fleshy fruit, as the apple.
Prickle. A small spine growing from the bark.
Puberulent. Minutely pubescent.
Pubescence. A covering of short, soft hairs.
Pubescent. Covered with short, soft hairs.
Punctate. Dotted with translucent or colored dots or pits.

Raceme. A simple inflorescence of flowers on pedicels of equal length arranged on a common, elongated axis (rachis).
Racemose. Resembling a raceme.
Rachis. The central axis of a spike or raceme of flowers or of a compound leaf.
Recurved. Curved downward or backward.
Reticulate. Netted.
Rugose. Wrinkled.

Samara. An indehiscent winged fruit.
Sapwood. The living outer portion of a trunk or large branch of a tree between the heartwood and the bark.
Scales. Small, modified leaves, usually thin and scarious, seen in buds and cones; the flakes into which the outer bark often divides.
Scaly. Provided with scales.
Scarious. Thin, dry, membranaceous; not green.
Scientific name. Two latin or latinized words denoting respectively the genus and species· e. g., *Acer saccharinum.*

Scurfy. Covered with small branlike scales.
Seed. The ripened ovule.
Sepal. One of the divisions of a calyx.
Serrate. Toothed, the teeth sharp and pointing forward.
Sessile. Without a stalk.
Shrub. A bushy, woody growth, usually branched at or near the base, less than 4.5 meters in height.
Simple. Of one piece; not compound.
Sinuate. Strongly wavy.
Sinus. The cleft or space between two lobes.
Smooth. Smooth to the touch; not pubescent.
Spatulate. Wide and rounded at the apex, but gradually narrowed downward.
Species. A group of like individuals, as soft maples.
Spike. A simple inflorescence of sessile flowers arranged on a common, elongated axis (rachis).
Spine. A sharp, woody outgrowth from a stem.
Spray. The aggregate of smaller branches and branchlets.
Stamen. The pollen-bearing organ of a flower, normally consisting of filament and anther.
Staminate. Provided with stamens, but usually without pistils.
Staminodium. A sterile stamen.
Sterigmata. The projections from twigs bearing leaves.
Sterile. Unproductive, as a flower without pistil, or a stamen without anther.
Stigma. The part of a pistil which receives the pollen.
Stipules. Leaflike appendages on either side of a leaf at the base of the petiole.
Stipule-scar. The scar left by the fall of a stipule.
Striate. Marked with fine longitudinal stripes or ridges.
Strobilus. A cone.
Style. The part of a pistil connecting ovary with stigma.
Sub. A prefix applied to many botanical terms, indicating somewhat or slightly.
Subtend. To lie under or opposite to.
Sucker. A shoot arising from a subterranean part of a plant.
Superposed. Placed above, as one bud above another at a node.
Suture. A junction or line of dehiscence.

Terete. Circular in cross section.
Terminal. Situated at end of a branch.
Ternate. In threes.
Thorn. A stiff, woody, sharp-pointed projection.
Tolerant. Capable of enduring more or less heavy shade.
Tomentose. Densely pubescent with matted wool.
Toothed. With teeth or short projections.
Transverse. Said of a wood section made at right angles with the axis of the stem; across the grain.
Tree. Usually defined as a plant with a woody stem, unbranched at or near the base, reaching a height of at least 4.5 meters.
Trunk. The main stem of a tree.
Turbinate. Top-shaped.

Umbel. A simple inflorescence of flowers on pedicels which radiate from the same point.
Umbellate. Arranged in umbels.
Undulate. With a wavy margin or surface.
Unisexual. Of one sex, either staminate or pistillate; not perfect.

Veins. Threads of fibrovascular tissue in a leaf, petal, or other flat organ.
Villose or *villous.* Covered with long, soft hairs.
Viscid. Glutinous; sticky.

Whorl. An arrangement of 3 or more leaves or branches in a circle round an axis.
Wood. The hard part of a stem lying between the pith and the bark.
Woolly. Covered with long and matted or tangled hairs.

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